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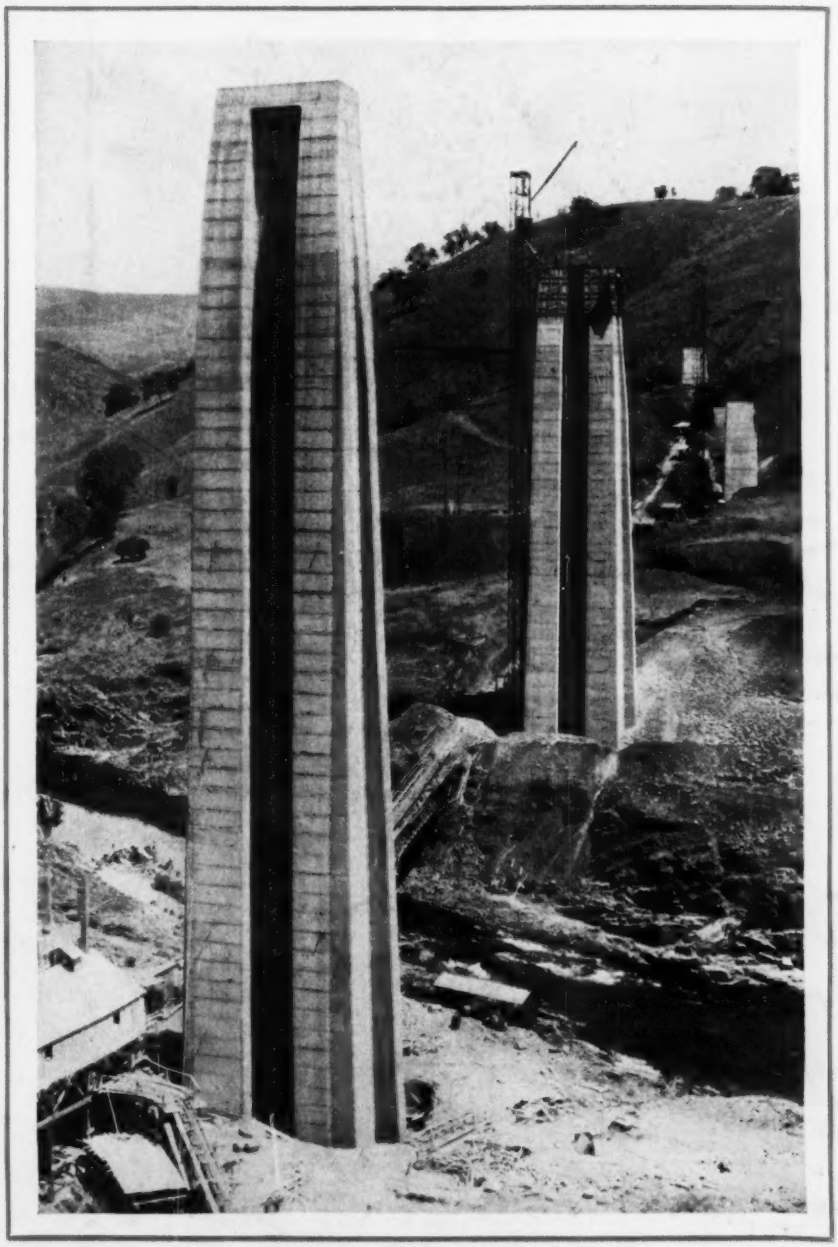

Bridge Piers 228 Feet High to Carry Yosemite R.R.
Across Reservoir Above Exchequer Dam

Concrete Arch Bridge Built as a Box Girder

Roofed Reservoir and Pipe Tunnel for Small Water System

High Bridge Piers for Yosemite Valley R. R.

Computing Back-water Curves for Surface Slopes in Streams

Buick Motor Company's foundry at Flint, Mich.; roofed with Federal Interlocking Tile; Federal Flat Slabs in gutter.

A decade of service has left this Federal Roof unscathed

A dozen or fifteen years do not comprise a very long moment in the history of the universe, but in the life of a roof they mean a great deal. In that length of time it becomes apparent whether a roof will stand the gaff or not. Most modern roofs will. Federal Roofs stand it to the point of practical permanence. They last as long as the structures they crown.

As an example, the roof of the Buick Motor Company's foundry at Flint, Michigan, shown above, has been in service ten years. The fact that it is as good today as the day it was erected speaks volumes for Federal Cement Tile. It shows no wear now and will show none after ten years more.

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ENGINEERING NEWS-RECORD

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
Editor

Volume 95 NEW YORK, OCTOBER 1, 1925 Number 14

Paying France's Debt

BY THE time this reaches the reader it may be that the spectacular M. Caillaux will have been able to put before the American commissioners at Washington some proposal for the reduction of the French debt that will stand a prospect of being accepted by this government. Certainly any move toward an adjustment of the international trade situation must wait until France starts to pay this debt in an optimistic mood. That is, the United States, not being a world philanthropist, must have assurance that the billions loaned in 1917 and 1918 are to come back with fair regularity and fair interest and France, on her part, must have the inner assurance, which is quite different from the outward propaganda, that in so paying she is doing only that which she can reasonably do. For any one who has not made an intimate study of that complicated organism, the financial conduct of the French Republic, to say how much and when France can or should pay would be a supererogation. But everyone knows that she can pay something and with inevitably increasing productivity can continue to pay more and that her whole future as an independent state depends upon her assuming those obligations as soon as possible. Her representatives at Washington are in the unpleasant position of having to solve an imperative foreign necessity with equations written in the language of domestic political strategy. Our sympathy should go out to them—but they will go back with an agreement to pay and that agreement will be as fair to France and to this country as anyone not a prophet could desire.

Quick Action Needed

REPRESENTATION of water-works engineers and superintendents by counsel, *amicus curiæ*, at the argument before the United States Supreme Court early in November in the Metcalf & Eddy and in the Detroit municipal railway employees income tax cases is a legal possibility that should be given quick attention by those concerned. How far from the original intent of Congress and the claims of justice the collectors of internal revenue are going in their demand that water-works men shall pay income taxes while practically all other municipal employees go free we discussed at length in our issue of Aug. 13. It is highly desirable that these and other pertinent matters be laid before the Supreme Court at the hearing. Doing so might broaden the opinion handed down by the court even though it could not specifically settle the case of the water-works men in municipal employ. At the least it might make clearer than now appears just what remedial legislation should be sought at Washington if that is found necessary. Those who wish to pursue the subject might take it up with their city law departments and with the income tax committees of the two water-works associations: George C. Andrews, water commissioner, Buffalo, N. Y., for the A. W. W. A. and Stephen H. Taylor, superintendent water-works, New Bedford, Mass., for the N. E. W. W. Association.

Snap Judgment on Concrete

WHENEVER there is a failure of concrete, that is, a complete structural failure with actual parting of the structure as distinguished from a surface raveling or disintegration, experts can always be found who will assert from visual examination that the concrete was obviously poor and had no strength whatever. In more cases than not such testimony is in itself evidence of a lack of intimate knowledge of the properties of concrete and should disqualify the witness as an expert. In rare instances concrete is so poorly made or of such undesirable materials that its insufficient strength is indicated by its surface texture. Its face is crumbly and the aggregate readily picked out from the matrix. There is no need to put a piece of it in a testing machine to tell that its compressive strength is practically nothing. But visual examination can never detect the difference between 700-lb. and 1,500-lb. concrete nor predict how much a concrete which is not obviously falling to pieces will test in compression. Too often we find engineers saying "that's good concrete" or "that's rotten concrete" as the case may be with no appreciation of comparative values or experience as to the relation between appearance and strength or service. The expert who has really studied concrete as a material, and not merely used it as a part of a structure, knows that he has to do more than merely look at a piece of concrete to tell how much it will bear and knows, too, that so far as bearing strength goes some mighty poor looking concrete will rate fairly high. Juries who have to listen to snap testimony as to poor concrete should be warned, by real experts, how much investigation is required actually to show that a given concrete is insufficient for the demands that were put upon it.

One Snake Scotched

CERTAIN kinds of magazines and newspapers thrive on the advertising of the fake correspondence school, which promises the ambitious young man huge salaries in the pursuit of some ordinary vocation once he has put in a negligible amount of time and effort in some course the school has to sell. Everything from the law down to real estate promotion has been so exploited but those activities concerned with the fundamentals or preliminaries to engineering have been a shining mark for attack. Draftsmen, according to the "come-on" advertising, are in the habit of making from five to ten thousand a year and soon become engineers at much larger return. Surveyors are scarce and expensive, with consequent large pay for those who can survey. The rudiments of these arts are soon learned

by mail and their complete conquest is a matter of only a continued subscription to the courses provided. Engineers have tried, with some success, to attack these frauds through the postal laws, but they continue to flourish. The current action of the Federal Trade Commission, noted in the news pages this week, is therefore much to be applauded. If the commission will now extend its ruling to the many other "schools" working the same field, the practice of engineering will be benefited and a number of earnest seekers of self-advancement will be saved money and disappointment.

Street Signaling a New Science

WARNING should be given those cities who are seeking a way out of the traffic tangle by the installation of mechanical signaling systems, particularly those of the synchronous electric type. The design and the layout of such systems is not for the amateur and unfortunately most of our municipal traffic directors are amateurs except as to those details common to the hand waving job of the traffic policeman. There has just been reported, for instance, one city that installed a synchronous start-stop system by virtue of which all of the street cars in a major section of the city were started at once, with consequent unprovided for instant load on the power house. The devising of a mechanical signal system is a highly technical piece of work, not only as relates to the machines themselves but also to their location and the processes of their operation. There are only a few engineers who have really studied the subject and the so-called traffic experts who dabble in this new science know less than nothing about either the demands or the service of complicated signaling. In the railroad service signaling long ago became a specialty in which the executive and even the maintenance engineer did not attempt to perfect himself. The analogous science of street signaling is still in its infancy but those who do know something about it are increasing. It behooves every city who feels that signaling is necessary to consult someone who knows rather than to attempt to originate designs or to select from rival manufacturers purely on a price basis.

Reducing the Gamble in Reclamation

FOR the first time in the country's history, the right to settle on public lands is limited by a qualification requirement beyond merely citizenship. The Reclamation Bureau has just put in force on existing projects the settler selection plan established by the new reclamation laws passed at the last session of Congress. According to the regulations established the settler must have $2,000 and two years of farm experience to be admissible.

Back of the new system is the hard fact that fifteen or twenty years of reclamation experience have shown that farming a piece of desert land under an irrigation ditch requires experience, capital, determination and hard work. Settlers who lacked experience and capital usually failed, and sooner or later had to go back, bankrupt, to their former occupations. They had, of course, taken this risk when they first decided to try reclamation farming, and their right to gamble against fate in this way is perhaps no one else's business. But their failure proved a serious injury to the progress of the reclamation projects, which makes the matter of much wider concern.

It is strongly asserted by many men of sincere convictions that the adventurous spirit which urges its possessor to stake his future on the long chance of success in making a productive farm home on the irrigated desert is of such remarkable value that nothing should be done to interfere with it. The system now established does interfere with it. It is on this point that sharp differences of view exist.

The advocates of unrestricted settlement assert that a man's freedom to shape his career, take a large risk in doing so, and if necessary make a failure, is a human right and should not be circumscribed; that the exercise of this right operates to single out the strong and bold and capable and makes them the pioneers and leaders of a new country. They say that any system of exclusion or selection is ruinous paternalism, a substitution of false and unnatural principle for the unerring natural selection upon which we must depend. Those who hold the opposite opinion point to the staggering list of failures in irrigation settlement, and insist that it is folly to lure doctors, grocery clerks and school teachers out into the sagebrush, equipped with ignorance of farming and wistful hope, to make inevitable failures. They cite as proof of this folly the huge losses that have resulted from the construction and operation of costly irrigation works supplying water to the farms on which these misfits and incompetents settled, never to contribute a single dollar to operating costs or repayment of the debt resting on the property.

But the views of the two opposing sides are not incompatible. One may concede the excellence of the pioneer spirit—the spirit of adventure, of willingness to bear hardship for a gambling chance of success—and yet recognize that practical considerations and financial prudence must also be kept in mind. The plain fact is that the delicate question in reclamation policy is not whether a man should gamble with his own money, but whether he shall be permitted to gamble with other people's money. Great sums of public money are at stake, and, what is perhaps more important, the welfare of his more capable neighbor-settlers, whose prosperity in part depends on his. The selection law passed by Congress and the new regulations of the Reclamation Bureau are intended as a partial protection against these evil results, not as a check to pioneering.

The settler prepared to buy a substantial equity in a farm is still completely free to take a flier in reclamation farming, though he may lack experience and be unfit. He is gambling with his own money. But the reclamation homesteader who takes up an irrigated farm unit on little more than an application-fee payment is in a very different position; the government is his partner. It has furnished him a piece of plant which cost $5,000 or $10,000 to build, and depends for repayment of this investment on the settler's chance of success in his farming. If the government seeks to protect its gamble investment by making sure that the settler is one who has reasonable chances of succeeding, it is exercising only ordinary prudence.

The case at present rests on the demonstrated need for this prudence in reclamation development. Under the original reclamation law the free-for-all principle was assumed to control. The results have been disappointing financially—almost disastrous. The hope back of the present change of system is to take out of reclamation development some of the gamble responsible for these results.

Over-Confidence or Worse

A SURPRISING piece of testimony came out in the *Shenandoah* investigation last week, indicating an almost reckless attitude of the headquarters officials of the Navy toward the vessel and its crew. Strict warning had been given by the designers that the *Shenandoah* was only a fair-weather ship, and that various storm conditions would subject it to immediate danger of destruction; yet naval headquarters insisted on regarding the ship as capable of meeting any conditions. The Bureau of Operations replied to certain cautionary suggestions of the commanding officer in this language:

> "If the limitations and apprehensions outlined . . . are sound, it would appear that our airships are of little military or commercial value. . . . However, the chief of naval operations is not ready to concur in those opinions and believes that these ships can be operated safely with the exercise of care and judgment within the discretion of the commanding officer and within reasonable limit of time. Thunderstorms and rains are likely to occur any time along the proposed route between June 1 and Oct. 1, but there is a high percentage of favorable weather with few protracted storms."

Unless the writer of this letter was ignorant of the designers' warning, he betrays an unfortunate assumption of superior knowledge. The Bureau of Operations may have been thus ignorant, but the Bureau of Aeronautics, to whom the letter was addressed, was thoroughly familiar with the design and its limitations, yet its reply does not indicate that the storm hazard received any thought. The correspondence gives support to the suggestion made in these columns three weeks ago (Sept. 10, p. 415) that over-confidence in the directing circles of the Navy was responsible for the *Shenandoah* disaster. But the case now seems rather worse, for if the officials failed to inform themselves of the ship's limitations or lightly waved them aside, their attitude is not to be excused on the score of the traditional fearlessness of the service. The inquiry so far has not touched upon this delicate point. However, the eye-witness facts which it has brought to light show that the events of the collapse check closely with the calculations and warnings of the designers.

Thus, the inquiry has established that the ship was involved in a violent storm at the time, that it encountered high-speed vertical currents of air of the kind the designers apprehended, that it was blown 3,000 ft. up and dropped again, and that it was navigated at full velocity with pitch angles several times as heavy as the maximum assumed in the design (15 or 20 deg. as against 6 or 7). These conditions were precisely such as would stress the structure of the ship practically to the breaking point, or (in view of the designers' optimistic estimate of the strength of the latticed struts) even beyond the breaking point. More than this, it was stated that not only had the safety valves been reduced to half their original number, but half of the remainder were closed off by tight covers, to save helium. That this exposed the vessel to the danger of bursting of gas bags if the ship should be driven above pressure height seems to have been treated almost as lightly as the storm hazard itself. In short, no heed appears to have been given to the ship's strength limitations by the headquarters authorities.

It is to be hoped that the further course of the inquiry will put the designers' warning on record and determine the reason for its being so airily disregarded.

Further Development of Structural Practice

SINCE the classic days of early rational mechanics, the column has occupied a distinguished place in the structural field, both as to theory and as to practice. It remains a key problem of modern steel bridge construction. Its present interest, however, lies more in its practical than in its theoretical aspects. Column formulas have been fairly well disposed of. On the other hand, questions of the kind raised in the article on column design published in this week's issue are those on which future discussion in the field of columns is likely to center.

The phenomena of buckling, highly complex in theory and even more complex in their practical relationship, have occupied many minds, and untold reams of paper have been written on them. Nowadays we feel confident that the net result of the consideration of buckling may be expressed quite simply for practical purposes, so long as the size and detail construction of the column and its factors of workmanship do not depart far from the customary. In this last proviso, however, extremely difficult questions are concealed.

One of these questions, the proper ratio between width and thickness of web plates of compression members, took on so important an aspect in the engineering design of the towers for the Philadelphia-Camden suspension bridge that elaborate large-scale tests were made in order to furnish a partial answer, sufficient for the design. This test work, however, is a rare exception; most questions of detail construction of columns are still uninvestigated. Future development of the engineering of columns will have to concern itself with them. The American Society of Civil Engineers already has a committee at work on detail problems of columns, but there is room for many workers in the same field.

Essentially the development from such work is bound to be non-mathematical. The two different lines of approach exemplified in the tests for the Camden bridge and in Mr. Christensen's article are likely to lead to specifications rather than to a theory of calculation; their end result will be to establish certain rules for adequate detail construction of columns rather than to make it possible to compute the strength of a column built without regard to rules of proper construction. Theory may be a necessary aid in developing and applying the rules, but it will at best play an auxiliary part in the problem.

In the light of the present renewal of activity in the field of long-span bridge construction the discussion of large bridge columns is particularly timely. The safety of a great deal of future construction, and for that matter its economy and efficiency, is dependent on better knowledge of the subject than we have yet developed. At the same time, it is well to keep in mind that the qualifying word "large" may not be a necessary factor in the case. At all events, our final knowledge of the subject ought to be such as to give equally complete and sound rules for the make-up of small and medium sized columns as of those required in building the great monuments of bridge engineering.

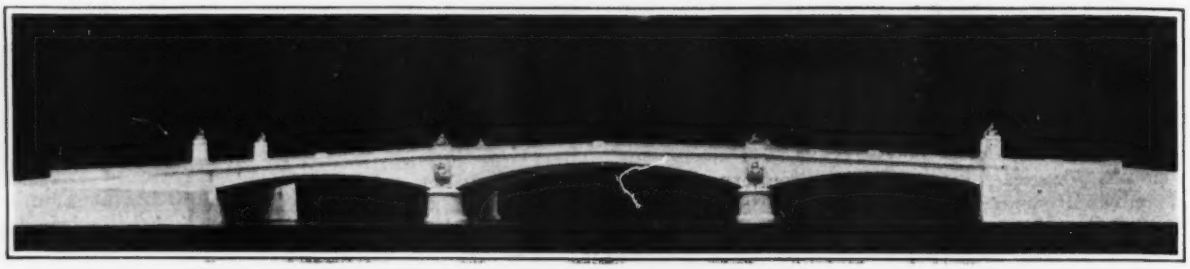


FIG. 1—ARCHITECT'S SKETCH OF OSWALD ST. BRIDGE, GLASGOW, SCOTLAND

Scotch Concrete Arch Bridge Built As Box Girder

Oswald St. Bridge at Glasgow Has Novel Form of Frame Due to Peculiar Conditions of Use and Location—Roller Bearings Distinctive Feature of Design

By W. L. Scott
Chief Engineer, Considere Constructions Limited, London, England

ONE of the most notable bridges in Great Britain is the Oswald St. bridge spanning the River Clyde at Glasgow, now under construction. Many bridges have been built of greater dimensions, either, or both, as regards individual spans and the relative altitude of the bridge platform. Some of these structures undoubtedly presented difficult problems from the point of view of design as well as erection, resultant from peculiarities of the site or specified conditions. Few, however, can have presented such a combination of conditions, natural and imposed, so difficult of satisfactory solution, as those obtaining in this bridge.

The special conditions may be briefly stated as follows:

(1) The levels of the existing roadways on either side of the river determined the longitudinal profile of the roadway.

(2) The requisite provision of uninterrupted navigable waterways in fixed positions determined the arrangement and soffit of spans, and limited the depths available for the temporary staging.

(3) The relative positions of the roads on either side of the river which the bridge connects required that the bridge be built on a skew, with an angle of 79 deg. between bridge center line and face of river quays.

(4) The width of the river influences the length of the spans.

(5) The proximity of the existing Caledonian Railway bridge and the Jamaica Street highway bridge established precisely the maximum depth, width and positions of bridge supports.

(6) The bridge must be designed to allow for the transport of the largest type of marine boilers to local shipbuilding yards.

These factors resulted in the profile illustrated in Fig. 2, specified by the city engineer, together with the following provisions for loads and stresses:

Loading—The bridge shall be designed to carry the following loads in addition to the dead weight of the structure, roadway and footways:

(a) Two lines of tramways occupying the central 18 ft. of the roadway and a distributed moving load of 1 cwt. per sq.ft. on the footpaths and portion of the roadway not occupied by the tramways. The two lines of tramways and the distributed load shall be assumed to be of limited or unlimited length, occupying the whole or any part of the length of the bridge, so as to give the maximum bending or thrusts upon the arch, abutments and piers. Each tramway car has a gross weight of 13 tons when loaded with passengers, with an over-all length of 30 ft. and a wheel base of 7 ft. centers of axles.

(b) The bridge shall also be capable of carrying an occasional single moving load of 120 tons, on two axles 9 ft. apart centers, with a gage of 9 ft. center to center of wheels, and drawn by a train of five tractors weighing 15 tons each, having 5 tons on front axles and 10 tons on rear axles. The distance between the wheels of the tractors will be 10 ft., with a gage of 8 ft. centers of wheels.

Provision for Corporation Pipes, Cables, etc.—In order to meet the requirements of the various departments of the corporation and the post office authorities, provision will require to be made in the design for the accommodation of the various pipes and cables as follows:

Post Office: Twelve pipes 3¼ in. diameter, two layers each of six pipes.

Water Department: One large water main, 35¼ in. external diameter; one 7-in. hydraulic pipe, outside measurement being 1 ft. 9 in. broad by 12 in. deep.

Gas Department: Two large gas mains. External diameter 31 in.

Electricity Department: Space required in the center of the carriageway for tramway ducts, 60 in. in width.

Provision will also require to be made at the curb line for eight tramway poles carrying the overhead wires, the position of these poles being behind the face of the abutments at each end of the bridge, and over the two piers.

Design of Bridge—"While it is intended that the bridge is to be designed as a ferro-concrete structure, it is desired that the bridge be faced with gray granite of approved quality, and that the parapets be constructed of gray granite. The width of the bridge between parapets is 80 ft. The width of the footpaths is 15 ft., leaving a width of carriageway of 50 ft.

"Provision will require to be made for a double line of tramways passing over the bridge. The tramways

will be laid in the center of the carriageway between the curbs. The width over all between the tramway rails is 14 ft., the tramway rails being laid to the standard gage of 4 ft. 8½ in."

Roadway and Footpaths—"The roadway between the footpaths will be paved with granite setts 6 in. deep, laid on a concrete foundation 6 in. deep, which will be laid by the corporation, as also the tramway rails. The footpaths, including the curbs, will also be laid by the corporation."

The bridge as finally designed allowed for a more severe combination of loading than that specified above.

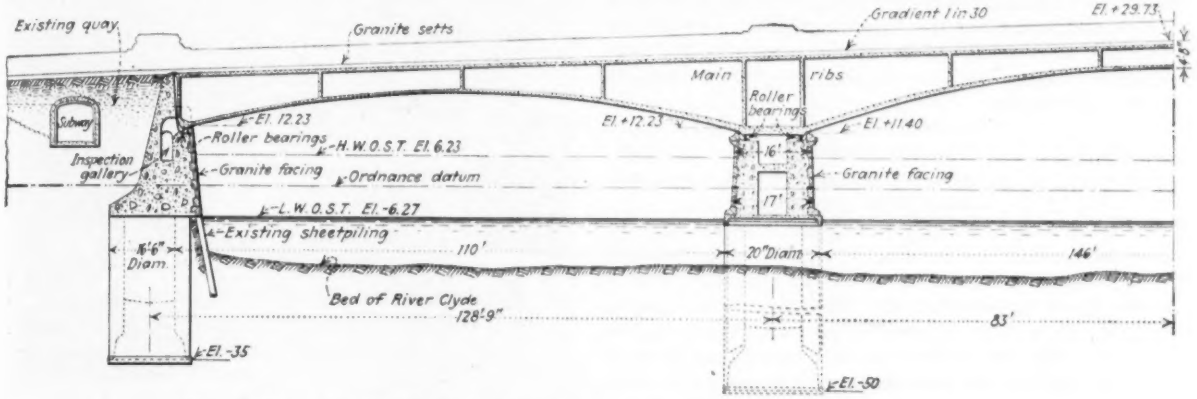


FIG. 2—HALF LONGITUDINAL SECTION OF BRIDGE, SHOWING BOX GIRDER TYPE

At the suggestion of the Ministry of Transport the bridge has been designed to accommodate the maximum 120 tons load and tractors, at the same time as the above specified tramway loading.

A very brief consideration of the profile in Fig. 2, and of the specified loading, etc., will make clear the extreme difficulty of producing a satisfactory design to comply wholly with the conditions which it was necessary for the city engineer to lay down; and it was

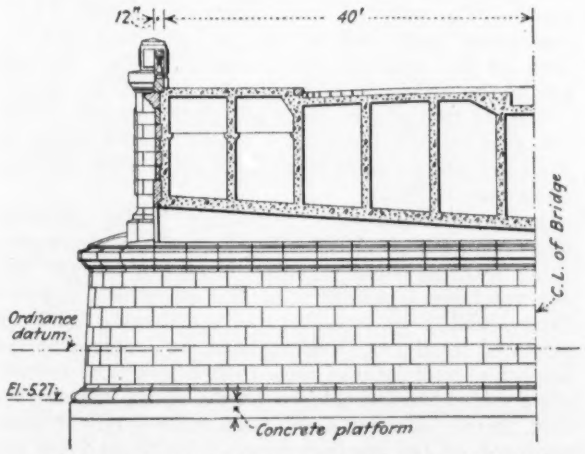


FIG. 3—HALF TRANSVERSE SECTION THROUGH OSWALD ST. BRIDGE

not until several alternative types had been carefully investigated and rejected that the successful design was evolved.

In considering the objections to conventional designs such as the hinged arch and cantilever types, it must be borne in mind that the bridge is in the center of the second largest city in Great Britain, and that appearance was therefore an essential consideration. The requirement of granite facing made the concealment of vertical joints in the spandrel faces and parapets, between supports, difficult to treat architecturally. Also the presence of tramway traffic and the large pipe mains to be accommodated made it necessary to keep the number of transverse joints across the roadway down to an absolute minimum.

The question of foundation pressure was vital on account of the limited depth permissible, and also the proximity of the adjacent railway bridge. At one point there is only about 25 ft. between the foundations of this and the new structure.

Elements of Design—In the effort to find a design which conformed to the specified conditions and at the same time one that satisfied properly all other essential requirements, the following points were adopted as a basis: (1) The lightest structure possible consistent with safety; (2) General form suitable for treatment with masonry; (3) Uniform pressure on foundations under all conditions; (4) Proper provision for free expansion and contraction at all supports; (5) No excessive bending moments at crown of center span which would render a proper arrangement of the steel reinforcement impossible; (6) Minimum number of transverse expansion joints.

It was evident, having regard to all these factors, that the only type possible was the continuous-beam type of bridge, but although such a bridge possesses the particular merit of stiffness and absence of vibration it is absolutely essential that movements due to changes of temperature in monolithic construction of this uninterrupted length be provided for if cracks and consequent disruption of the granite facing are to be avoided. It therefore becomes necessary in such a design to provide some possible means of horizontal movement between the bridge superstructure and the supports upon which it rests. The exact arrangement finally decided upon is described below.

Foundations—The river pier foundations consist of circular caissons 20 ft. in external diameter founded approximately 61 ft. below the underside of the bridge platform. The tops of these caissons are at about low water level (ordinary spring tides). The water at this level has an average depth of 9 ft. and the average penetration of the intermediate caissons below the river bed is therefore 36 ft. The abutment foundations also

comprise circular caissons, their external diameter in this case being 16 ft. 6 in. and their founded level being about 47 ft. below the underside of the bridge platform.

Pier Construction—Construction and sinking of the caisson foundations for the river piers of the bridge were carried out with a certain amount of ingenuity.

The shells were constructed complete with the shoe and with a false bottom, and, when complete, the caissons were floated out at a suitable high tide to the positions they were to occupy in the river. Fig. 4 shows one of the caissons leaving the river bank and being warped into position. As will be seen from Fig. 5, the forms for the external shells are composed of steel plates and the steel reinforcement for the completion of these caissons *in situ* was left projecting from the concrete.

At low water the caissons are grounded and allowed to settle some feet into the river bed. At this stage, the temporary bottoms are removed and the internal thickening of the caisson walls proceeded with.

To insure the caissons remaining vertical and in order to control the sinking generally, arrangements were made in the design to enable the internal concrete thickening to be placed in any position desired. While the sinking was in progress, the completion of the external shells and thickening was carried on from a stage arranged a few feet above high water level. The tops of the caissons were approximately at low water level and consequently the construction of the river piers required to be done either by tide work or by the use of cofferdams.

Cofferdams—The cofferdam method was employed and their construction facilitated as follows: Sections

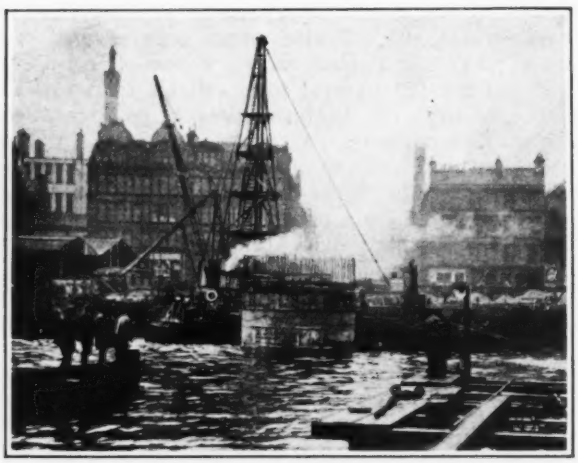


FIG. 4—FLOATING PIER CAISSON TO PLACE

of the cofferdam, including the bottom platform, were attached to the tops of each of the circular caissons and sunk with them, as the caissons descend. Only the junctions between these cofferdam sections then were required to be carried out by tide work and when this was done, a complete cofferdam, the full length of the river piers, was obtained, in which the connecting transverse lintel beam (which is granite faced) could be constructed entirely in the dry.

Similar arrangements were employed for the abutment foundations excepting that in these cases the caissons were constructed over their final positions.

Connecting the upper ends of the river pier caissons are massive transverse reinforced-concrete lintels extending in height from L.W.O.S.T. to a few feet above H.W.O.S.T. The abutment caissons are connected by transverse sleeper beams, also in reinforced concrete and extending to a few feet above high water level.

Manholes through the pavements give access to inspection galleries along the transverse river and abut-

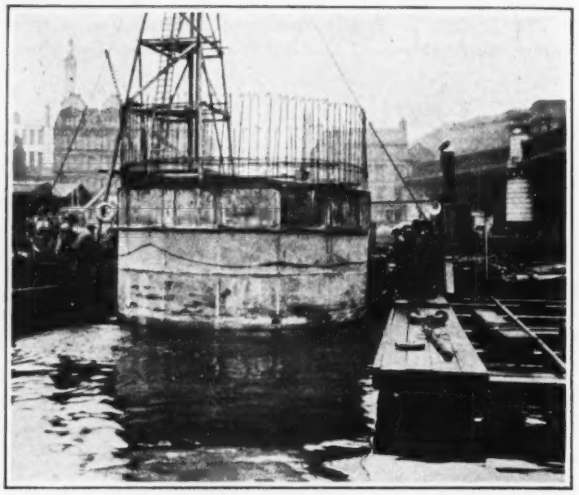


FIG. 5—PIER CAISSON PARTLY SUNK

ment beams, for the purpose of examining the roller bearings.

The bridge superstructure spans between the abutments without interruption and vertical transverse expansion joints are provided over each abutment.

Superstructure—The superstructure is carried by twelve independent continuous beams, parallel to the parapets and arched on the soffit of each span so as to conform exactly in this respect with the specified profile. The soffits of these beams are connected by a continuous vault slab of varying thickness and the tops by the roadway and pavement slabs. By this means the underside of the bridge has an appearance similar to that of a masonry structure, in keeping with the architectural finish as a whole. Cross beams or walls are introduced at intervals to provide the requisite transverse stiffness.

Roller Bearings—The monolithic bridge platform rests upon cast-steel roller bearings at the abutments, these bearings being arranged in such a manner that the reactions transmitted to the abutments increase their stability by opposing the overturning tendency produced by the earth filling retained. Moreover the horizontal component of these inclined reactions induces compression throughout the length of the superstructure, thereby effecting a reduction in the tensile stresses produced by the bending moments resultant from the vertical loading.

The principal feature of the design is in the method employed for supporting the superstructure at the river piers. Upon each of the transverse lintel beams connecting the river pier caissons, two rows of cast-steel roller bearings (of the same type as those at the abutments) are introduced, one near either face of the beams, Fig. 2.

The bearing plates of these rollers are inclined so that movement of the superstructure at these points is a circular rotation about the centers of the caissons at foundation level. In this way, whatever may be the points of application of live-loads, the foundations have only to take reactions which pass through these centers of gravity, thereby ensuring absolutely uniform pressure upon them.

Finally a device is employed in construction which eliminates the difficulty of excessive tension at crown of center span. It may be noted that the depth available for the reinforced construction at this point is 4 ft. 8 in. This device, which has been carefully taken into account in the design, consists in the omission of a transverse strip of concrete at the center of the center span until the remainder of the concrete and granite work is completed and the temporary staging slackened. This results in a double advantage since there are no dead-load bending moments across the center of the bridge and because the stresses produced in the portions of the bridge on either side of the center line due to the dead-load are statically determinate.

The bridge at this stage consists of beams spanning from the abutments to the river piers and having cantilevers approximately equal in length to half the center span. This condition produces maximum bending moments at the river piers, where the depths of the longitudinal beams are greatest and no bending moments in the middle of the center and shore spans, where the depths are least. Static methods of investigation are obviously preferable to those necessitating the determination of "unknowns" by a study of elastic deformation. The latter method could not of course be entirely dispensed with and had to be utilized in investigating the maximum stresses produced by the superimposed loading.

It will be noted that during the period of construction in which the central strip of concrete is omitted, the roller bearing at the abutments must of necessity be prevented from functioning as such. To insure this, reinforcement is introduced temporarily connecting the superstructure with the foundations, which is cut after the completion of the concreting; then the inclined rollers are permitted to act, bringing upon the superstructure the requisite horizontal compressive force.

With the arrangements outlined, the various requirements assumed to be essential at the commencement of the investigations are satisfied entirely. In addition, the design was quite straightforward and permitted definite calculations to be made for the stresses coming upon the work without recourse to theories involving assumptions which are actually indeterminate. The stresses in the above structure have been carefully kept within normal limits and the calculations, which were necessarily extensive and somewhat laborious, were carefully checked by and received the unqualified approval of the Ministry of Transport engineers.

Considerable study was given to the architectural aspect of the problem with some success, as Fig. 1 shows.

Personnel—The designing engineers for the bridge are the Considere Constructions Limited, of London, and the contractors are Melville Dundas & Whitson of Glasgow.

Substitute Ties and Tie-Plates in France

METAL ties are being used to an increasing extent in tie-renewals on railways in France, according to a report presented at the recent International Railway Congress. Some railways use them not only on account of the scarcity and cost of wood ties, but also as a means of reducing maintenance expenses. There is said to be general agreement, however, in limiting their use to lines on which the speed of trains does not exceed 56 to 62 m.p.h. The same reasons have led these railways to an extensive trial of concrete ties. As some experimental stretches of track have carried several thousand trains without the slightest effect on the concrete or the fastenings, it is considered that concrete ties will give long and excellent service. In regard to lines of light traffic, conclusive results as to stability of track and economy in labor and material for maintenance have been obtained by the Paris & Orleans Ry. with the concrete ties and blocks on its line between Hautefort and Terrasson, as described in *Engineering News-Record* of May 1, 1924, p. 761.

In regard to metal tie-plates, however, it is rather surprising to note that although a large number are still in service, their further use has been "almost completely abandoned." The objections noted are the noise caused by trains and the fact that with combined wear of the rails and plates the screw spikes cannot be brought into contact with the rail base. However, some engineers are placing shoulder tie-plates under rails having a narrow base and also on curves, where the shoulder will relieve the spike from some of the thrust of the rail. Tie-plates of compressed poplar are being used in some cases to prevent the cutting of the ties, but it may be added that wood tie-plates have not proved satisfactory on American railways.

Colorado Health Board Engineering Division

The Division of Sanitary Engineering of the Colorado State Board of Health, created by last-minute action by the State Board of Health after three months' struggle, is empowered (1) to give advice on water supply and purification, sewerage and sewage treatment, and to supervise nuisances growing out of the operation of works for these purposes; (2) to investigate "causes of disease, especially epidemics," besides making other sanitary investigations; (3) to maintain chemical, bacterial and biological laboratories. The act calls for a director of the division who must be a sanitary engineer, graduated in civil or sanitary engineering from a recognized university or technical school, with a record of experience, and holding a Colorado engineer's license; a bacteriologist of similar general educational qualifications. The appropriations for the new division are $7,000 a year for each of the years 1925 and 1926. The director of the division is Dana E. Kepner, formerly assistant engineer with the Sanitary District of Chicago and prior to his present appointment sanitary engineer for the Colorado State Board of Health under a co-operative arrangement with the International Health Board. The position of bacteriologist (part-time basis) has been filled by the appointment of Bert Lincoln. The two named constitute the technical staff of the division thus far.

Roofed Reservoir and Pipe Tunnel for Small Water System

Circular Flat-Roof Concrete Structure—River Tunnel for 24-in. Main—Construction Methods and Rapid Progress

TO STORE the water supply of Calumet City, Ill., a 2,000,000-gal. circular concrete reservoir has been built, with a tunnel to carry the inlet main under the Grand Calumet River. The population of Calumet City (formerly West Hammond) is about 15,000. A recent contract with the city of Chicago provides for a supply of 2,000,000 gal. daily at 62½c. per 1,000 cu.ft., the water being delivered between 1 and 5 a.m., when the Chicago demand is at its low point. A 24-in. cast-iron main serving the intermediate towns of Colehour, Ford City, Hegewisch and Burnham, passes through the river tunnel and terminates at the reservoir, about 1½ miles south of the Chicago city limits. There are now 33 suburban or outlying towns supplied from the Chicago water system and taking an aggregate of 17,500,000 gal. daily.

Reinforced-Concrete Reservoir—The circular reservoir (Figs. 1 and 2) is 180 ft. in inside diameter and 13 ft. high, with a 15-in. wall and 8½-in. floor and roof; the roof and 3 ft. fill are supported by 97 columns 20 in. in diameter. A sump 7x8 ft. in. plan and 5 ft. deep provides for the outlet, while a concrete box of the same size on the floor contains the inlet; each has a 24-in. cast-iron pipe ending in an elbow, which is turned up for the inlet and down for the outlet. An 8-in. iron pipe drain leads from the bottom of the sump to a sewer. A 6-ft. excavation was made with teams and slip scrapers, the material being stored for use as backfilling. All concrete is a 1:1¾:3 mix, made with 1½-in. washed gravel and washed torpedo sand and with 5 lb. of hydrated lime added for each bag of cement. A 21-S. steam-driven side-loading concrete mixer was placed on the bank, about 13 ft. above the floor level, with a plank platform for storing the materials.

The floor slab, 184½ ft. in diameter and resting on a sand bed, was poured in four sections with a No. 13 zinc plate 18 in. deep to form the joints. A 42x12-in. footing was formed under the wall and a 24x9-in. footing under each joint. Concrete for the floor was spouted from the mixer to a 1-yd. hopper and thence wheeled on temporary runways. A float finish was given to the floor, which was then covered with sand and kept wet for ten days. The circular wall was poured in two sections, with zinc-plate vertical joints and a joint at the floor. Wood forms were made of

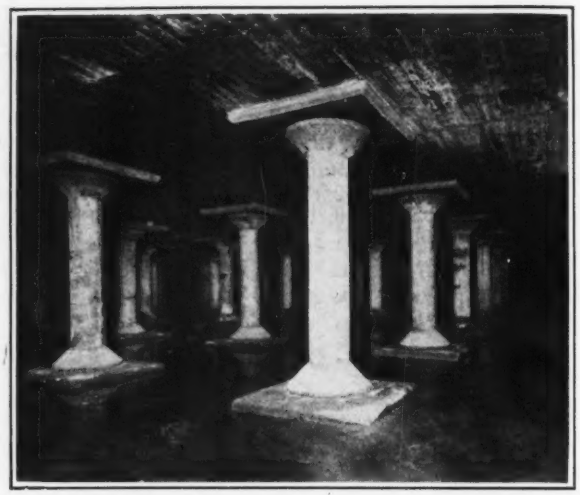


FIG. 1—INTERIOR OF COVERED RESERVOIR AT CALUMET CITY, ILL.

2x6-in. uprights 18 in. apart, with 1-in. boards. Circular segments were cut for the uprights to rest upon and to form the circle of the wall. After the forms were removed, the spreader holes were filled with 1:2 mortar and both inside and outside surfaces of the wall were brushed with a 1:2 paint-like mortar to fill all the small air holes; the wall was then kept wet for ten days.

Columns and Roof—Concrete for the columns and roof slab was poured from the top, with carts run on

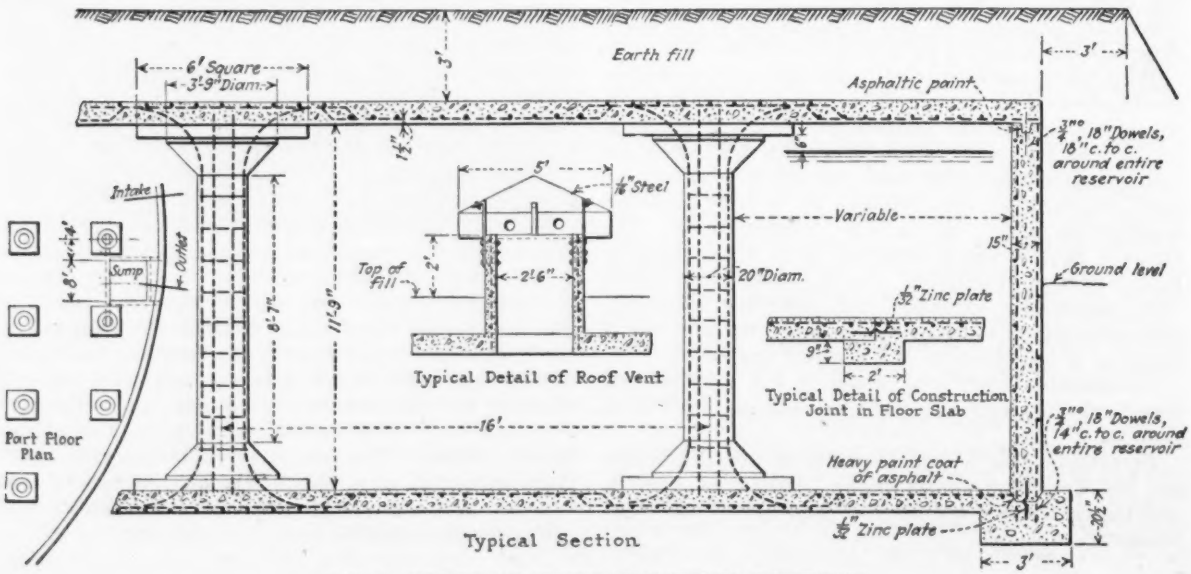


FIG. 2—DESIGN OF CIRCULAR COVERED RESERVOIR

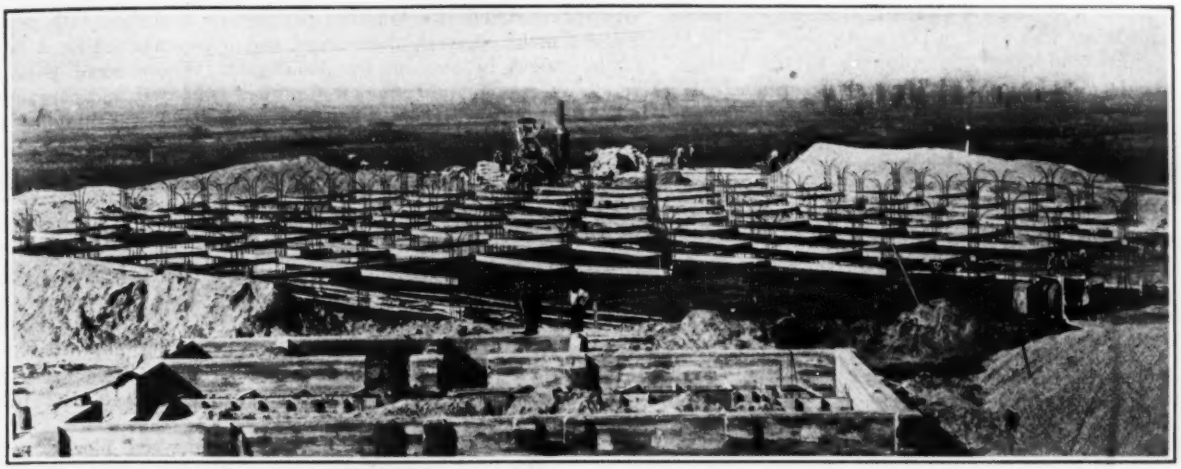


FIG. 3—REINFORCING STEEL IN FLOOR AND COLUMNS OF CIRCULAR RESERVOIR

a temporary runway resting on the roof form supports. Steel forms were used for the columns. For loading the carts, the concrete was elevated with a 24-in. portable gas-driven belt conveyor 28 ft. long, discharging into a 1-yd. hopper on the roof form supports. The roof was poured in four sections with zinc plate joints. The forms for the roof rested on 4x4-in. supports, with 4x6-in. girders, 2x6-in. stringers and 1-in. floor boards. Four concrete ventilators in the roof are 30 in. inside diameter with 4-in. walls 5 ft. high; these vents are covered with a fine-mesh bronze screen and capped with a steel hood 5 ft. in diameter. A 4x6-ft. manhole frame and cover was placed in the roof over the inlet pipe.

After the concrete in the roof had set it was covered with 30 in. of sand and 6 in. of black dirt, dressed to a 1 on 2 side slope around the wall. Before the backfilling, the reservoir was filled with 4 ft. of water to test the joint between floor and wall. No leaks were found after 48 hours and the reservoir was then disinfected and backfilled. The reservoir required 2,200 cu.yd. of concrete, 115 tons of reinforcing steel, 1,500 lin.ft. of zinc plate for joints, 5,000 cu.yd. of excavation, 7,500 cu.yd. of backfilling and one acre of black dirt and seeding.

Siphon Tunnel for Water Main—Dredging in the Grand Calumet River necessitated the construction of an inverted siphon tunnel for carrying the 24-in. main from Chicago and this tunnel was made large enough for future gas mains and telephone and light cables. It is 7x7 ft. in section, with an arched top and 10-in. walls; the floor slopes 6 in. to a sump at the south shaft for drainage. At each end of the tunnel is a 10-ft. shaft 60 ft. deep with 18-in. walls; these shafts are 263 ft. c. to c. to provide for a 250-ft. channel. Nearly all of the excavated material was taken out of the south shaft and will be used for covering the sand in an adjacent park. The general design of the tunnel is shown in Fig. 4.

Shaft Sinking—For the first 15 ft. of the south shaft the excavated material was fine water-bearing sand with a few layers of shells and gravel; the north shaft was through black muck for about 15 ft. with a layer of gravel and shells on top of the clay. The remainder of the shafts was through clay, small boulders and small pieces of slate, the clay getting

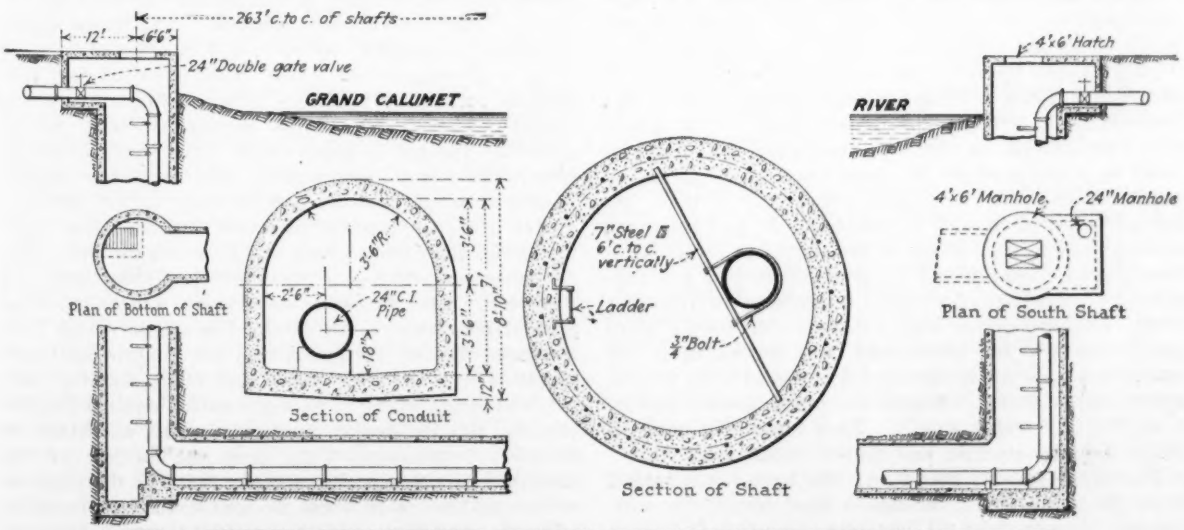


FIG. 4—INVERTED SIPHON TUNNEL CARRYING 24-IN. MAIN UNDER GRAND CALUMET RIVER
Pneumatic spades used for excavating in stiff clay.

harder and tougher as the shafts were deepened. Open dredging was used in the south shaft to the top of the tunnel and then underpinning to the bottom. Little water was found 35 ft. below the surface, though small waterbearing sand pockets were encountered. Below 45 ft. the muck was excavated with pneumatic spades or hand shovels and hoisted in ½-yd. tip buckets.

Cutting edges of 4x4-in. angles and an 18-in. plate, with 36-in. anchors spaced 24 in. apart, were used for both shafts, as at the pipe tunnel under the Indiana Harbor Canal (*Engineering News-Record*, April 13, 1924, p. 574). Wood shaft forms were left in place for 24 hours and after their removal both the inside and outside surfaces of the shell were brushed with a 1:2 paint-like mortar to fill all small air holes. The

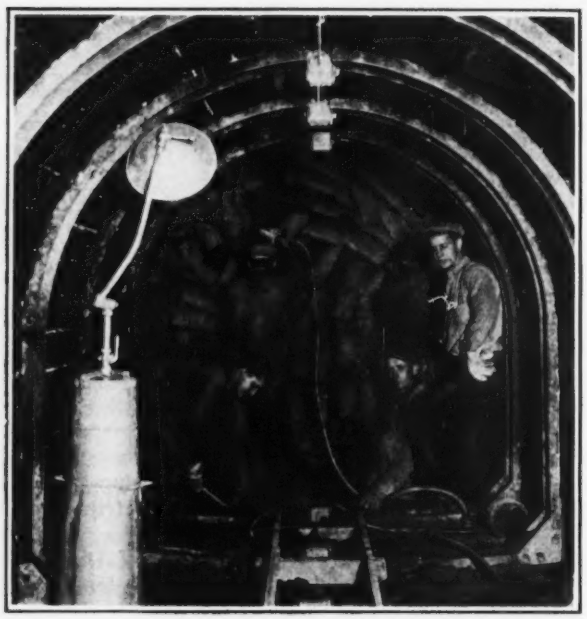


FIG. 5—PIPE TUNNEL AT CALUMET CITY, ILL.

walls were reinforced with ½-in. rods 24 in. apart in both directions.

At the south shaft the equipment consisted of a small traveling derrick of 11-ft. gage with a double-drum steam hoisting engine and 40-ft. boom to handle a ½-yd. clamshell bucket. The north shaft equipment consisted of a 2-ton stiff-leg derrick with 36-ft. boom and operated with a 12-hp. gas-driven hoist. Little water was encountered, so that the excavation was done by hand to a depth of 40 ft.; then pneumatic shovels or spades were used. The shell was concreted upon the top and allowed to sink for about 40 ft. and then was underpinned to the bottom of the shaft. Air for ventilation and for operating the pneumatic shovels was supplied by a 10x10-in. horizontal compressor driven by a 40-hp. gasoline engine with a 5x6-ft. receiver for storage. Concrete for each shaft was mixed in a 7-S gas-driven concrete mixer, and was placed with a ½-yd. bottom-dump bucket. Water was piped about 1,000 ft. from the city water supply. Each shaft was sunk in thirty days by six men and a hoist engineman.

Tunneling—About 250 ft. of the tunnel was mined from the south shaft, through a hard tough clay containing slate and small boulders, about 6 ft. being mined and concreted on each 9-hour shift. Each shift consisted of a hoisting engineman, 3 miners with pneumatic shovels, 2 muckers and 3 top-men. Fig. 5 is a view in one of the headings. Where sand pockets occurred the tunnel was mined, timbered and concreted in 3-ft. sections. Excavated material was handled in ½-yd. buckets on cars running on a track with 16-lb. rails; these buckets served for both the muck and the concrete. Carbic lights were used in the tunnel headings. Steel form ribs were made of 6-in. 8-lb. channels, in two pieces, with angle-iron lugs at top and bottom for bolting together, with a 3-in. wood spacing block; the lagging was 2x6-in. lumber with beveled edges. Gravel concrete of 1:2½:4 mix was used in both shafts and tunnel, that for the tunnel being shoveled and tamped into the forms. After 24 hours the forms were removed and the surface brushed with a 1:2 thin mortar to fill all small holes.

With the 24-in. pipe placed on wood blocks, concrete blocks were cast under it 8 ft. apart. In the shafts the pipe was anchored to 7-in. 15-lb. channels spaced 6 ft. apart, by means of ¾-in. U-bolts (see Fig. 2). A 24-in. gate valve is placed in a valve chamber at the top of each shaft, reached by a steel ladder from the tunnel. Each shaft roof is provided with a 24-in. manhole frame and cover and a 4x6-ft. frame and doors.

Engineers and Contractors—The Subway Engineering Co., Chicago, was contractor for the reservoir and siphon tunnel, while the Public Construction Co., Hammond, Ind., had the contract for laying the pipe. The Consoer Engineering Co., Chicago, was engineer for the work. The siphon tunnel, with shafts, cost about $50,000 and was completed in three months. Rapid progress was made also on the reservoir, where excavation was started Sept. 15, 1924, and the first and last pourings of concrete were made on Oct. 13 and Nov. 19, 1924. Its cost was about $90,000.

Flat Worms Cause Trouble in Water Supply

Living flat worms known as *Planaria* began giving trouble to the water supply of an incorporated village in New York State late in October, 1924, and have given trouble infrequently from time to time since. A report on the trouble made to Dr. Matthias Nicoll, Jr., state commissioner of health of New York, by C. A. Holmquist, director, Division of Sanitation, contains the following facts and recommendations: The water supply is from a spring-fed reservoir of 1 m.g. capacity, filled from a drainage area which is uninhabited but subject to occasional visits of hunters, woodcutters and others. The drainage area is covered with second growth. The soil is porous sand. The water is almost always clear even after a rain. The daily consumption is said to be less than the flow of water to the reservoir. Water is drawn from the reservoir through a 6-in. cast-iron pipe, the inlet to which is 3 ft. above the bed of the reservoir near the toe of the earth dam that forms the reservoir. The water is not treated and there is at present no screen to the inlet. The water mains have not been flushed systematically and contain sediment supposed to come from leaves and other material that get into the reservoir. As a precaution against further trouble, Mr. Holmquist recommends that an intake be provided terminating 3 ft. from the surface of the reservoir in a fine basket screen; that the distribution system of the water-works be well flushed at frequent intervals; and that if further trouble occurs a pressure mechanical filter be installed.

Engineering in the Small City

A series of notes from the field on the Problems and Practices of the Municipal Engineer in the Cities Below 100,000

The Editor Visits the City Engineer

Snapshots of Our Representative Small Cities

Manchester, N. H.

MANCHESTER ST., MANCHESTER, N.H.

LARGEST CITY IN NEW HAMPSHIRE, and one of the county seats of Hillsboro County. Manchester is situated 18 miles southeast of Concord, the state capital, and 56 miles northwest of Boston. The city is on the Merrimac River at its confluence with the Piscataquog and extends along both sides of the two rivers. Water power from Amoskeag Falls, in the Merrimac, is carried by a well laid out system of canals to the industries of Manchester. Chief of those industries is manufacture of cotton and woolen cloth; other industrial works are paper mills, knit goods factories, fire-engine and locomotive works and carriage and wagon works. Pop. 1920, 78,000.

MANCHESTER is the typical New England textile manufacturing city. Its growth has largely been a reflection of prosperity of its chief textile plant—the Amoskeag mills. As a matter of fact the Amoskeag Corporation practically built the original city and until two years ago paid about one-third of all city taxes. All of the property at that time which the corporation owned was maintained by it. That meant many of the streets were maintained by the corporation. Two years ago, however, the city made public all of the streets within the corporation's holdings, and put the maintenance of these streets on the same basis as all other public streets. The city sprawls along the two sides of the lazy Merrimac River, most of it, however, being on the east side. Lying as it does on the undulating slopes the city is afforded natural disposal of storm drainage and sewage, the river still being far from a saturation point.

The city government is composed of the board of mayor and aldermen, which body appoints the various commissions and officials except the police commission, which is appointed by the governor of the state. The highway department of the city is responsible, by an act of the New Hampshire Legislature made effective in 1921, for the construction, repair and maintenance of highways, bridges and sewers; the collection of wastes, including ashes, garbage and refuse; the cleaning of streets; the plowing and removal of snow from roads and sidewalks; maintenance of the city yards; and the regulation of encumbrances, obstructions and traffic upon the city streets. These responsibilities are placed on the highway commission and the surveyor. The commission is composed of three members, one of whom is elected each year for a term of three years by the board of mayor and aldermen. By the statute the commission appoints a surveyor, preferably a civil engineer. The present surveyor is L. B. Hoyt, who was formerly assistant civil engineer with the Massachusetts Department of Public Works, Division of Highways. His wide experience in highway work has been a most valuable aid to his present position, for Manchester is a city covering 34 sq.mi. and having 200 miles of streets to maintain, only 12 per cent of which are paved.

Details of City Engineering—The surveyor, with the approval of the commission, appoints three superintendents: one for highways, one for sewers and another for street cleaning. In addition to these three main divisions of the department he has a staff of engineers, responsible only to him. He also has a central buying organization similar to that found in council-manager towns. The present surveyor has instituted a patrol system of maintenance for roads and streets. At the present time only one man is employed on this work, covering the city three times a week. This patrolman reports on dangerous conditions such as washouts after storms, potholes, etc., and foremen or sub-foremen are sent out to make the needed repairs. Other responsible positions are as follows: a master mechanic, in charge of all mechanical equipment; a superintendent of motor transportation and one superintendent of the construction yard, where the plant, equipment and materials are located. The entire force employed in the highway department numbers over two hundred men.

The construction program for the current year is based on appropriations and bond issues; the appropriation for general maintenance totals $380,000, and the bond issues amount to $300,000. The general maintenance appropriation is allotted to the following divisions: highway maintenance, street cleaning, refuse disposal, equipment and materials and sewer maintenance. The bond issues are allotted to street paving, storm drains and sewers. Mr. Hoyt has adopted a graphical system, supplemental to the bookkeeping, for comparing each of these accounts with expenditures during the past four years. Graphs are also kept up to date to show the progress in street paving and sewer construction. This graphical representation is an easy means of explanation to all interested as to the expense and progress of work.

How Construction Is Handled—The city of Manchester has done practically all the work in the past by local labor and so has acquired an unusual amount of equipment. The inventory value at the beginning of this year was $143,000, including $60,000 for materials on hand, $25,000 for trucks, $11,000 for road machinery and $11,000 for street cleaning equipment. The department has its own asphalt plant, capable of producing an average of 800 cu.yd. of bituminous concrete daily for paving work.

With this equipment on hand, it has been possible to reduce the cost of gravel and gravel stone for the city's use. Early this year, after calling for bids on sand, stone and gravel, it was found that the prices were considerably higher than the cost of the materials the

department could acquire itself. Several gravel deposits were found in the city and one most favorably located was operated by steam shovel. This bank furnished approximately 20,000 yd. during April, May and June—sufficient to supply the major needs for this construction season. The gravel stone was used mostly as a base course for bituminous concrete on sandy subsoil roads. The saving to the city on this gravel has been considerable. With this source of supply available, a more ambitious program of street maintenance has been and will be possible. The gravel was used for surfacing sand roads and compacted under traffic. Light oil was then applied at the rate of ½ gal. to the square yard. The surface was then dragged, rolled and treated with a second application of oil.

Some of the more important streets which contained a goodly proportion of stone were scarified and reshaped, new stone added and asphaltic oil of heavier grade applied. In the case of main thoroughfares and important residential streets a 2-in. bituminous concrete pavement on a 6-in. gravel stone base has been used. A limited amount of 5-in. granite block paving on a 4-in. concrete foundation, also 3-in. asphalt penetration on 5-in. stone base has been laid.

Sewers—The five-year sewer program, which Fay, Spofford & Thorndike laid out in 1922, was largely construction of new storm interceptors with laterals and an enlarged outfall. With such new construction the system, which is now a combined one, can be separated. Construction of the new outfall was done in 1923, but until this year little else had been done in carrying out the program which called for a total outlay of several million dollars. However, storm sewer work became active with the laying of the first large sections of the trunk. Reinforced-concrete pipe of an inside diameter of 84 in. is being used. Approximately $50,000 worth of pipe of that and smaller sizes is stored in the city yards. With storm water separated, the existing sewer system will be adequate to carry the sanitary load. This storm drain construction is being done by contract.

Present collection of ashes and rubbish is made daily in the business district, three times a week in the semi-business district and twice weekly in the more populated residential districts. For collection the department uses three motor trucks, ten to fifteen teams and from forty to fifty men, depending upon the season. Rubbish is disposed of on dumps, short hauls being made in the winter and the more distant dumps in the summer. In the snow season sleds are used for collection.

The city, during the past four years, has spent an average of $100,000 annually for the disposal of refuse and ashes. Garbage has been collected by licensed collectors who feed it to hogs. This method of household garbage collection has led to some complaint, inasmuch as the collectors' tendency is to make collection to suit their own convenience, but that has been overcome to a large extent by the city's employing a paid collector who does nothing but follow up complaints.

Since there is so much money involved in refuse disposal, the department has been making a survey to determine means of cutting down the cost without impairing the service, having assigned the investigation to an engineer in the department. Men have been assigned to each wagon to record how much waste is taken each time from each house. With such data it will be possible to re-district the city according to volume of collection.

Snow Removal—As the snowfall is heavy, the highway department is well equipped for snow removal. Trucks with blade plows push the snow into gutters. A 10-ton tractor with a plow is used on hilly streets and drifts. During the past two seasons, a snow loader and trucks have been able to clear the principal business section within 48 hours.

There are 31 bridges located in Manchester; of these, 16 are steel bridges, 11 wooden, 2 stone arch and 2 reinforced concrete. The maintenance of these bridges has consisted in re-planking the decks and making minor repairs to the steel bridges, and replacing corroded stringers, beams and other parts. Several bridges were painted this season, the more important steel structures being previously sandblasted.

Though the tenure of Mr. Hoyt dates only from Jan. 1 of this year, and he is operating his office under a system that is comparatively new to that city, it is apparent that engineering administration and business methods are building up an office and field force that will operate with increasing efficiency. The fact that the surveyor is beholden only to the commission, which is composed of public spirited men of local prominence, is, in his opinion, responsible in a great measure for results obtained.

Engineering Work

Land Subdivision Survey Costs

By Reeve Conover
Del Monte Properties Co., Pacific Grove, Calif.

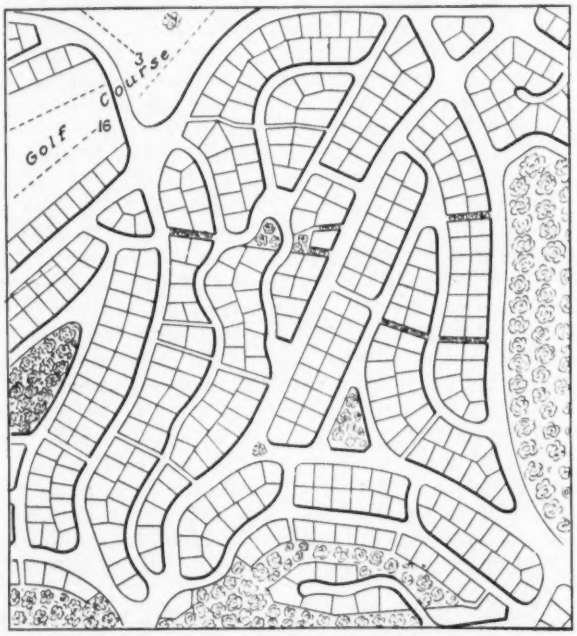
THE Monterey (Calif.) Peninsula Country Club is a subdivision project embracing 1,600 acres centering around a club house and two 18-hole golf courses. The first unit has been completed and costs on the surveying work are here given. The entire tract is very brushy, and covered with a dense growth of pines and oaks. Orders were that no trees of any value were to be cut by the survey parties and compliance with these added to the cost of the work. Practically every foot of line had to be cleared and the average progress of a good party was about 1,000 ft. a day when running out curved road lines from an office location with all notes furnished.

A layout of the subdivision was made from a 200-ft. to the inch 5-ft. contour map which had been made ten years before and which was precise enough for the flatter country. In addition to this, topography was taken on about 93 acres of the first unit where the older map was not sufficient (owing to the fact that no horizontal control points had been preserved). Alignment notes were figured and given to the transitmen who ran out the roads, keeping on alternate notebook pages a set of traverse notes showing deflection angles and slope distances and slope angles. These traverses were balanced after a network of them had been completed. The roads were inspected and changed for about 10 per cent of their length to miss important trees and to fit the country better.

Of the Small City

Ties were then figured from the locations of the balanced transit line points to the correct locations of curve points where concrete monuments were afterwards set. This system distributes the errors of closure over the entire tract. Reference hubs were set from monuments so their location could be checked after the roads had been constructed.

Before any computation was done on the lot dimensions these were scaled from a map layout and bearings measured with a protractor. The lots were then staked out, using the compass for line and measuring only approximately. Stakes were set and numbered



CHARACTER OF SUBDIVISION LAYOUT

with crayon. This cost $0.99 per lot but had two advantages: (1) it permitted changes to be made in the lot layout without wasting any computation work, and (2) gave the sales force the opportunity of becoming acquainted with the country. In many cases changes were made to keep large trees near property lines. Accurate lot stakes were set later.

On account of the brush and trees some work that would ordinarily be done by the field parties was figured in the office. Ties were computed from the road location tangents to the lot corners on the roads, so that except in occasional instances the transit parties set additional points along the already cleared lines and offset to the property corners. This added to the office work, but simplified field operations.

Transitmen and computers were paid $175 per month, chainmen $4 per day and the engineer in charge $375 per month. The following is a tabulation of the cost on the first unit which comprises 1,094 lots and 523 acres, not including the golf links:

Design, superintendence and inspection of roads and lots	$1,513.00
Topography; 93 acres @ $2.16 (does not include control lines)	202.00
Road locations from office location notes 95,093 ft. @ $1.56 per 100 ft.	1,488.00
Straight line traverses for topographic control and gulley locations 6,785 ft. @ $2.09 per 100 ft. (extremely difficult country)	142.00
Monument locations and reference stakes—364 points @ $2.46 each	894.00
Setting approximate lot stakes for 1,094 lots @ $0.99 per lot	1,080.00
Setting exact stakes for 1,094 lots @ $2.48 per lot	2,710.00
Setting 6 x 18 in. concrete monuments, with large copper rivet for center point, 330 @ $1	330.00
Miscellaneous surveys	512.00
Equipment (10 per cent yearly on transits, 20 per cent yearly on computing machines, and cost of tapes, axes, etc., used up)	500.00
Stakes	552.00
Computations	3,392.00
Drawing and rechecking computations on 22 filing maps	967.00
Sales maps	469.00
	$14,751.00

Cost per lot $13.50
Cost per acre 28.20

Above amounts include liability insurance and truck mileage. No construction engineering cost included. No general company overhead included. $1,900 spent on golf links surveys and topography not included.

In addition about $1,000 was spent on layouts and surveys which were abandoned on account of a complete change in the design of the golf links. This seems to be an inevitable expense on every subdivision project of any size, and while it is not chargeable to the engineer, it is his duty to call attention to the waste of money and the more serious waste of time that comes from variations in the plans.

I should estimate that in fairly open rolling country such as southwestern Ohio a similar survey could be made for about $20 per acre.

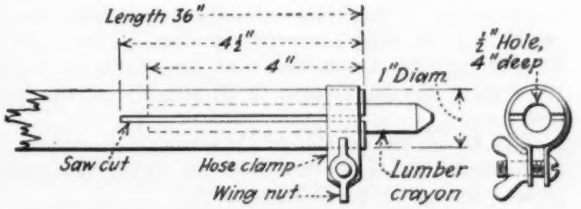
The design of the golf links was made by Seth J. Raynor and the subdivision design and surveys were made under the supervision of the writer.

Marking Stick for Condemned Brick

By Leonard G. Howell
City Engineer, Ironton, Ohio

A MARKING stick to assist in the hasty and easy marking of condemned brick in street and road construction was designed by the writer, as shown in the accompanying sketch, for the use of the city's paving inspectors. By the use of the marking stick, the inspector is enabled to work rapidly and always in an upright position. Ordinary lumber crayon is used for marking the brick,

The construction of this marking device is very simple, a good stick and an ordinary garden hose clamp with bolt and wing nut being the only materials



DETAILS OF INSPECTOR'S MARKING STICK

required. The stick is bored out at one end, to admit the crayon and saw cut, so that by the use of the hose clamp the crayon can be adjusted as used and held firmly in place.

This device in frequent use has proven itself to be a help to the city's paving inspectors.

Detail Design of Large Bridge Columns

Points to Be Considered in Designing Built-Up Columns for Full Efficiency of Material—Percentage of Angle Area—Lacing, Battens and Stitch-Riveting

By C. L. Christensen
Assistant Bridge Engineer, Niagara River Bridge, Michigan Central R.R., Detroit

A BUILT-UP compression member should be as strong as if cut out of a solid block, to obtain maximum strength with minimum weight. The following remarks, intended to help toward attaining this result, refer particularly to the design of very large compression members, with areas of several hundred square inches.

Ratio of Angle Area—In large compression members the stress-carrying main material consists of plates and angles. What is the proper ratio of angle-area to the total area? This question is one of those which cannot be solved by higher mathematics.

The corner angles give lateral stiffness to the web between the connections for the lacing. If cover plates are used, the corner angles serve as a transfer path for stress from the gusset plates to the cover plates. They prevent skew collapse of the member by the bending strength at their fillets. It is apparent that the ratio of the angle area to the total area should be made as large as possible, after proper attention has been given to the thickness of the web-plates and cover plates.

It is usually prescribed that the thickness of the web-plates shall be at least $\frac{1}{50}$ of the distance between the nearest rivet lines in the angles. The safety obtained by following this rule depends on the strength of the angles, the lacing, the diaphragms, the rivet connection between the webs and the angles, and the spacing of the stitch rivets in the webs. In a typical closed square section consisting of two web plates, two cover plates and one angle at each corner, with uniform thickness of metal, if the leg of the angle is $\frac{1}{8}$ of the width of the web then the ratio of the angle-area to the total area is 20 per cent. We may consider the member as a box girder in which one flange consists of two corner angles and a cover plate. For girder flanges it is generally prescribed that the angle shall form 50 per cent of the flange area, but for a compression member the girder action is secondary to the direct compression, so that the longitudinal shear between the plates and the angles becomes smaller. It may therefore be considered sufficient that the angles form 33.3 per cent of the flange area or 20 per cent of the total area.

With lacing on one side of the square, the angle area in a similar typical member becomes 25 per cent; with lacing on two sides, 33.3 per cent.

These ratios cannot of course be considered as more than tentative values, but that some approximate ratios should be used as guidance in detail design is proved by the startling variations found in the makeup of the compression members in long-span bridges. The Queensboro bridge has compression members whose angle area is only 7.1 per cent, the angle area being 80 sq.in. and the total area 1,120 sq.in. The first Quebec bridge had a ratio of 11.3 per cent, with total area 781 sq.in. The old cantilever bridges, Monongahela, Thebes and Memphis, have much larger ratios, but with areas below 350 sq.in.

We see here instances of a general tendency to decrease the ratio of angle area as the total area increases. This is natural; there is no easier way of obtaining a large sectional area than by adding plates on plates. There must, however, be a limit beyond which this becomes unsafe. Even among recently built bridges of the simple-span type, with similar sectional areas and similar arrangement of plates and angles, one bridge may have a ratio of 14 per cent and another a ratio of 28 per cent in its compression chords.

The use of high-strength steel makes it easier to obtain a larger ratio with the angles rolled at present. For very large compression members, 1,000 sq.in. or more, 10x10-in. or 12x12-in. angles may be advantageous with corresponding increase in thickness of legs.

In tests made by the Bureau of Standards on ten columns for the Metropolis bridge, five columns had a ratio of angle area of 31 per cent while the other five had a ratio of 50.5 per cent. Both of these ratios are high, but the columns with the higher ratio had at the point of failure an average unit stress 10 per cent higher than the columns with the smaller ratio. The sectional area was only 76 sq.in. but conclusions can nevertheless be drawn in favor of a large angle area also for larger sections. The authors of the report give a somewhat different explanation of the difference in strength (Technologic Paper 101, Griffith & Bragg).

Lacing and Battens—In bridges with web members connected to the gussets outside of the chords, the compression chords usually have two webs connected by a cover plate at the top and by lacing at the bottom. Members large enough to admit a man for painting and inspection may have cover plates at top and bottom. In yet larger members, there may be added a longitudinal system of lacing or batten plates along the center line of the webs, which with a further increase in section may be changed to a solid longitudinal plate, dividing the section into two closed sections.

The solid strength of compression chords of this type is not so easily obtained if the web members are pin-connected at the center line of the chord, because the cover plates then must be stopped at the panel points (bottom chords of cantilever bridges). Even in simple spans it is often found desirable to omit the top-chord cover plate to make center lines of web and section coincide and have pin-connection more open for inspection. A longitudinal diaphragm may be connected along the center line but it must also be stopped at the pin. It will further form a trough where snow and ice, dust and ashes will collect. The usual construction, therefore, is to have two, three or four ribs connected by lacing at top and bottom and possibly along the center line. In this type of compression member there is no transverse continuity of the main material;

each rib carries its own direct stress for the whole length of the member in parallel co-operation with the other ribs. The lacing must prevent buckling of the individual ribs and resist shear on the whole column.

It is known that a value of 2½ per cent of the direct stress covers the shear in long columns due to eccentricities and deflections, and also covers the shear in short truss-members due to secondary stresses. Each rib being stayed at the connections for the lacing, if the distance between connections is short the individual bending of the rib may be neglected, so that it is unnecessary on that account to decrease the permissible unit stress for the whole column. For each rib section the value $(l/r)(c/r)$ should be less than 40 and less than that of the whole column. In this expression c is the distance from the center of gravity to the extreme fiber of the part considered. Omitting the factor c/r would lead to error, since it is considerably larger for the rib than for the whole column.

The lacing system must also have a certain amount of strength in bending at right angles to its own plane, so that it to some extent can fix the corner angles in the same manner as a cover plate. Considering that a cover plate also takes its full share of the direct compression stress, it may be sufficient to specify that the bending strength of the lacing at right angles to its own plane shall be one-half the strength of a properly designed cover plate.

The lacing system has, of course, a tendency to partake in the direct column stress. But as the transverse components of the compression stress in the lacing easily can deflect the web segments, the direct compression stress in the lacing can only be small. Even if there is a double system of lacing diagonals with transverse ties at the connection, the direct compression stress is not more than 3,000 lb. per sq.in., and the total stress in the lacing resists less than 1 per cent of the total direct stress in the member. These values hold in applying the work equation to the column and lacing.

Long and strong batten plates are used at the ends of the lacing system. But intermediate batten plates are not substituted for lacing on compression members except for members with longitudinal center diaphragm. Batten plates are not in favor, because too much was expected of them in former times and now they are not given credit for what they can do. Intermediate batten plates have some very good qualities. They do not deflect the ribs sideward as the lacing does. They can also, to some extent, help out if there is a local inequality in the web segments. The open space between battens should not be longer than the panels used in a lacing system. The battens must be strong enough to fix the unsupported ribs, which will be bent in double curvature by the column shear. The local moment at the end of the batten is then three times the moment at the center of a rib in a laced panel, because the bending on a cantilever from a single force S acting on an arm $1/2L$ is twice the moment at the center of a span L uniformly loaded with $2S$. For a rib between two batten plates these effects must be added. The column with batten plates is therefore at a disadvantage with regard to local bending. For long columns the shear at the center is zero, so that the local bending stress, at the point where the bending moment on the whole column is maximum, is due to the local column action of the rib only.

For short columns with a large shear throughout from secondary stress action, the bending moment on the whole column section must be considerably smaller at the center than at the ends, which are protected by strong batten plates.

The rivets connecting the rib to the battens must act as flange rivets, the column being a girder with the ribs as flanges. The rivets must also fix the ribs to the battens to resist the local bending. These two shearing actions are at right angles to each other.

It would be of interest to make comparative tests between columns with lacing bars and columns with intermediate batten plates. The same amount of material and rivets should be given the lacing bars and batten plates. This was unfortunately not done in the tests made by the American Society of Civil Engineers and American Railway Engineering Association, where between 2½ and 3 times as much material and rivets were given to the lacing bars as to the batten plates. The batten plates were much smaller and spaced much farther apart than would be done in actual construction.

The best arrangement is lacing with a double system of diagonals with transverse ties at the connections, combined with intermediate batten plates riveted to the intermediate diaphragms.

Transverse Diaphragms—Transverse diaphragms are useful not only during manufacture, shipping and erection but also in the finished structure. They keep the section rectangular and help the corner angles to keep the webs and cover plates straight so that they do not bend, bulge and twist separately. In cases of single lacing or double lacing without crossties at the connections, the intermediate diaphragms prevent the ribs from spreading at these points. It is hardly possible to make a close quantitative estimate of the value of the diaphragms except where an eccentric load is directly applied to the chord at or near the diaphragm, but their unifying effect is evident, particularly in members with lacing. The diaphragms should preferably fill the whole cross-section and be connected to all four sides of the member. In members with lacing, intermediate batten plates can be placed at the diaphragms and be riveted to them as above mentioned. The spacing is usually made about 8 ft., depending on the dimensions of the member. The diaphragms must fit exactly to avoid initial bending stresses. A diaphragm which distorts the section is not an asset, but a liability.

The minimum strength of the diaphragm is dictated by the handling of the member in the shop and during erection; the member can for instance be supposed to rest on one edge, supported at one point at the diaphragm. This or some similar assumption will determine the minimum compressive and shearing strength of the diaphragm.

Stitch Rivets—Stitch rivets are used to connect several web plates into a built-up web of the same column strength as one solid plate of the same thickness. To prevent the individual plates from buckling, the stitch rivets are spaced about 12 times the thickness of the thinnest outside plate in the direction of the compression stress. Closer spacing (about 3½ in.) must be used in the rows along the edges to make the joint watertight.

The shearing strength of the rivets must prevent the individual plates in the built-up webs from sliding on

each other, if they all get a tendency to curve in the same direction. Unequal temperature may cause considerable internal stress, but the main consideration is the tendency to buckle under compression.

An approximate value can be obtained by equating the negative term in the column formula to the bending stress in a simply supported column built up of longitudinal plates riveted together. By approximate computation the writer has arrived at a longitudinal unit shear at the half thickness of the built-up web of 200 lb. per sq.in. As a 1-in. rivet has a shearing value of 10,600 lb. per sq.in. it can accordingly take care of 50 sq.in., not counting on the friction between the plates. This value is probably on the safe side.

The rivets will get considerable tension due to the clamping together of the plates, which may not be perfectly straight. There may also be some tension and pull on the rivet heads, when the material due to the column compression expands transversely, i.e., in the longitudinal direction of the rivets, unless the rivets fill the holes completely and thereby partake fully in the compression and therefore elongate as much as the transverse expansion of the web.

Attainable Column Strength—The various parts of a built-up column which make the main material act as a unit can to some extent exchange functions. We can, for instance, as an extreme hypothesis imagine that the webs and cover plates are connected at the corners by longitudinal hinges instead of by angles, and yet skew collapse could be prevented by diaphragms spaced sufficiently close. But if we omit one of these essential features and the others are weak, if, for instance, the ratio of angle area is low, the lacing has only a fraction of the required strength, there are no intermediate diaphragms and the end-diaphragms only connect the upper half of the ribs—then we can expect failure.

If a column is carefully designed and tested and its length-ratio l/r is about 30, then the average unit stress at failure may be 10 per cent above the mean tension yield-point of the material and 20 per cent above the lowest yield-point observed in a test piece. Another short column designed by experienced men may nevertheless have local weaknesses caused by faulty design so that the average stress at failure is only 75 per cent of the mean tensile yield-point. This is a very considerable variation. But even in the stronger column there is very likely considerable variation in the stress intensity at failure at a given section. This variation should, by careful arrangement of the metal, be reduced to a minimum, so that a short column will fail as a block. When a column has been stressed beyond the yield-point at any point the result is, of course, a deformation which can be termed a structural failure; but if there is no snapping or breaking, then a total collapse may be prevented—at least a sudden and disastrous collapse under an accidental and short-time overloading may be forestalled.

The ideal column section is a hollow cylinder with diaphragms at intervals. In the rectangular column built up of plates, angles, lacing, diaphragms and rivets there are many chances for sudden failure of some detail and complete collapse as a consequence. There is here a large field for improvement in design and verification by tests. It should be possible with homogeneous material and careful detail design and test of a short column to obtain an average unit stress at complete collapse which is far above the yield-point.

Vehicular Subway under Market St. in San Francisco

Crossing Under Loop at Ferry Greatly Decreased Congestion—Soft Mud Complicated the Construction Below Water Level

MARKET St., the most important thoroughfare and business street in San Francisco, crosses, at its lower end, the Embarcadero, a still wider street that runs along the waterfront and fulfills an important function in the city's shipping and commercial traffic generally. The intersection of these two main arteries is made the more important by the fact that it is crossed by an average of 140,000 people per day throughout the year going to and from the ferry building at the foot of Market St.

To reduce congestion at this intersection, a vehicular subway has recently been built parallel to the waterfront and under the terminal loops of the street railway tracks on Market St., thus providing an uninterrupted thoroughfare for traffic along the Embarcadero and relieving the street-car loop of interruptions due to that traffic. The subway, wide enough for one line of traffic in each direction, is to be supplemented eventually by another tube placed alongside. Traffic in each tube can then be limited to one direction which will more than double the capacity because it will permit slow-moving vehicles to be passed by those that move faster.

In studying traffic conditions at the intersection prior to building the subway, the Board of State Harbor Commissioners made a traffic count from 7 a.m. to 6 p.m., during which time about 8,000 vehicles and 4,000 street-cars crossed the intersection. In this period the passage of vehicles along the Embarcadero caused an entire cessation of street railway car movement for a total of 4 hr. 48 min. and, of course, there was a corresponding tie-up of vehicular traffic during the same period totaling 6 hr., 12 min. The subway was put in service on May 2 and immediately eliminated interruptions due to cross traffic at the intersection.

While these preliminary studies were being made the question arose as to whether slow-moving horse-drawn drays would slow up motor-truck traffic through the subway to a serious extent. This did not prove to be the case, partly because the capacity of the subway is at least 50 per cent in excess of the traffic using it at the present time and also because the percentage of horse-drawn vehicles is low. On May 8 a traffic count showed only 232 horse-drawn vehicles passing through the subway in a 12-hr. period.

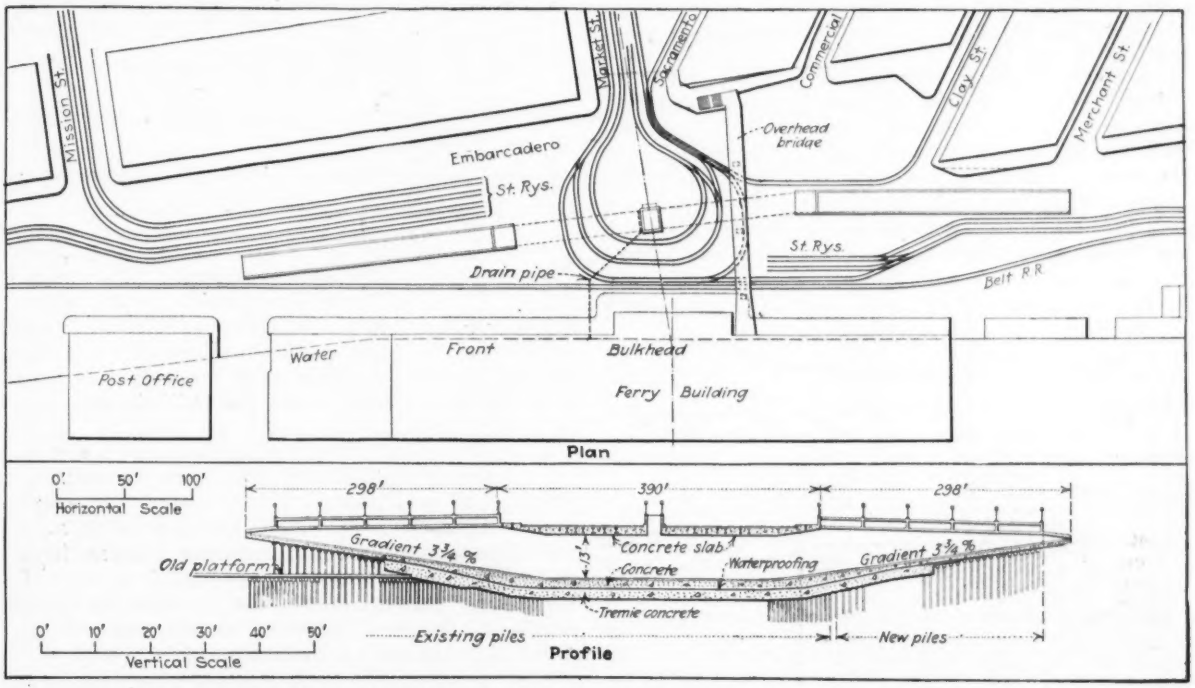
The subway consists of two open approaches, each 298 ft. long on a grade of 3.75 per cent, and a central closed section, 390 ft. long. The closed section was made long enough to extend under the street-car loops and an 85-ft. width in addition on either side of the loops which is reserved for pedestrians and automobiles going directly to or from the ferry building.

The roadway width in the subway is 21 ft. 8 in. between curbs, and the clear height is 13 ft. The tube is built wholly of reinforced concrete except that the street railway loops are carried in the roof of the closed section on structural steel members.

At the point selected for the construction of the subway the Embarcadero is carried on a timber platform supported on wood piles. This platform was built

13 ft. below the street surface and carries a sand fill on which the street paving was laid. The piles supporting it were used in designing supports for the subway and, where required, additional piles were driven.

As originally laid out, the construction program called for the removal of the timber platform and the driving of sheetpiling to enclose the trench after which the piles under the platform were to be cut off at grade, additional wood piles driven where required, and the trench bottom sealed with 3 ft. of tremie concrete before attempting to unwater. When the contractor got under way, however, the bottom was found to be fairly tight and tremie concrete was used only



PLAN AND PROFILE OF EMBARCADERO SUBWAY UNDER MARKET ST., SAN FRANCISCO

where considerable water came through the bottom as the trench was being pumped down. Thus about 15 per cent of the bottom length was given the layer of tremie concrete and over the remainder a 2-ft. layer of concrete was placed later, working in the dry. Considerable difficulty and delay, however, arose from the leakage of water into the trench through the sheetpiling side walls.

These side walls consisted of 12 x 12-in. timbers with which 3-in. splines were used in grooves to give the tongue-and-groove effect. The old platform had been blasted away to permit the driving of this sheetpiling, but this blasting was done under water and stubs of timbers or piles remained in the path of the sheetpiling. This disrupted the alignment and required much patching and redriving to make the walls tight enough to permit unwatering.

With the trench unwatered, outer forms for the concrete walls were built up of 2-in. tongue-and-groove. On the 2-ft. concrete layer in the bottom and up these side wall forms to a point above high water level was placed a membrane waterproofing consisting of 6-ply, 14-lb. roofing felt impregnated with asphalt. Inner forms were then placed and the floor and walls of the subway were poured, giving a concrete backing, as it were, for the waterproofing membrane, which had been placed before concrete was poured.

Drainage is provided by iron pipe drains in the concrete walls leading to a sump served by a motor-driven centrifugal pump with a 4-in. discharge, automatically controlled by a float. The subway is lighted by electric lights at intervals of 20 ft. on either side, placed in recesses in the concrete at the junction of side walls and roof. Daylight is admitted in the center of the closed section by an 18 x 23-ft. opening located in the center of the street-car loops. The lighting is reported to be unnecessarily brilliant with the short length of closed section and the central skylight. A 40-ft. spacing, it is now believed, would have been sufficient.

The work has been done under the general direction of the State Board of Harbor Commissioners, of which Frank G. White is chief engineer. General contract for the construction of the subway was awarded Nov. 1, 1923, to the Tibbitts Pacific Co., for $238,700. In addition to this the amount expended by the board for cement and equipment brought the total cost to approximately $342,000. This total cost was distributed as follows: The Board of State Harbor Commissioners, 50 per cent; the city of San Francisco, 25 per cent; the municipal railway, 12½ per cent; the Market St. Railway Co., 12½ per cent.

Standardized Safe Water Signs On Highways

Plans for the erection of standardized signs indicating where safe drinking water can be obtained along the main traveled highways of the country are being made by the American Automobile Association, Pennsylvania Ave. at 17th St., Washington, D. C. Much work to this end has already been done by some of the state boards of health.

Computing Backwater Curves for Surface Slopes in Streams

A Method Suited to Irregular Channels—Change in Velocity, Channel Friction and Energy Losses Considered

By J. C. Stevens
Stevens & Koon, Consulting Engineers, Portland, Ore.

THE method of computing backwater curves herein described has been used with success by the writer for determining the surface slopes in streams above dams or for the extension of flood slopes from some point on the stream where flood elevations are known. The accuracy of the final results depends upon the number of cross-sections taken in the stretch under consideration, and upon the accuracy of stream flow data. In uniform channels the surface curve may be computed directly by the method outlined by Alva G. Husted (*Engineering News-Record*, April 24, 1924, p. 719), wherein the length between given depths or elevations is directly expressed in terms of known quantities. (Mr. Husted has made no allowance for eddy losses, but they can be included without vitiating his method.) In irregular channels, however, the "trial and error" method must be followed. The problem, therefore, is to reduce the labor involved to a minimum.

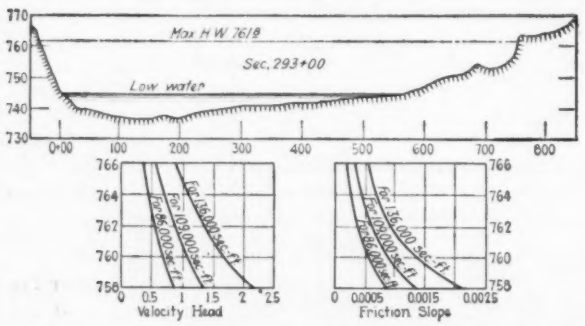


FIG. 1—CROSS-SECTION OF A RIVER WITH CURVES OF HYDRAULIC ELEMENTS FOR BACKWATER COMPUTATIONS

Surface Curves—The principal factors influencing the surface curve are channel friction, changes in the mean velocity, and energy losses due to eddies, impact and cross currents. The latter will be grouped under the single term, eddy loss.

Friction Slope—The friction slope represents the energy lost (converted into heat) as the result of friction between the prism of moving water and its containing channel. Its determination is purely empirical, for which the Kutter, Manning, Bazin, Williams and Hazen or other exponential formula may be used. The writer has used the Kutter formula. Friction slope does not coincide with surface slope—unless the mean velocity remains constant—because all changes of velocity involve the expenditure or recovery of surface elevation.

Eddy Losses—Eddy loss represents energy lost as a result of cross currents, eddies, and impact caused by obstructions and changes in the configuration and alignment of the channel. The distinction between friction and such eddy losses is purely one of convenience. Eddy losses are always present where the mean velocity is diminished, but increase of velocity, unless sudden, does not cause an eddy loss. The changes in configuration of the channel are shown by the cross-section, hence, cross-sections should be taken in sufficient number to depict all important changes in the channel. Between such cross-sections, therefore, eddy losses must be allowed wherever velocities decrease downstream, but no allowance should be made for increasing velocities. No general formulas have as yet been devised for such eddy losses.

TABLE I—HYDRAULIC ELEMENTS OF SECTION 293+00

e	*W*	δA	*A**	δW	δP	*P**	*R*
744 9	570	....	2,589	.....	.....	570.9	4.53
46 0	589	637	3,226	19	19.1	590.0	5.47
48 0	614	1,203	4,429	25	25.3	615 3	7.20
50 0	652	1,266	5,695	38	38.3	653.6	8.72
52 0	693	1,345	7,040	41	41.2	694.8	10.13
53.0	698	695	7,735	5	5.4	700.2	11.04
54 0	755	726	8,461	57	57.0	757.2	11.18
56 0	772	1,527	9,988	17	17.5	774.7	12.89
58 0	779	1,551	11,539	7	8.1	782.8	14.74
60 0	786	1,565	13,104	7	8.1	790.9	16.58
62 0	791	1,577	14,681	5	6.6	797.5	18.42
63 0	794	792	15,473	3	3.7	801.2	19 31
65 0	859	1,653	17,126	65	65.1	866 3	19 76
66 0	876	867	17,993	17	17 1	883.4	20 35

		109,000 Sec.-Ft.			136,000 Sec.-Ft.		
e	*C*	*V*	h	*f*	*V*	h	*f*
758 0	67	9 45	1.34	.00136	11 79	2 16	.00211
60 0	69	8 32	1.08	.00088	10 37	1 68	.00136
62 0	70	7 42	0.86	.00061	9 26	1 33	.00095
63 0	71	7 05	0.77	.00051	8.79	1 20	.00079
65 0	72	6 37	0.63	.00044	7 94	0 98	.00062
66 0	72	6 06	0.57	.00022	7 56	0 89	.00054

e = elevation of water surface
W and δW = width and increment to width
A and δA = area and increment
P and δP = perimeter and increment
R = hydraulic radius
C = Kutter coefficient
V = mean velocity
h = velocity head
f = friction slope

*Computations carried to more places than actually used, to avoid accumulative errors.

Energy Gradient—The energy gradient is a line joining the energy head at all points of the channel. The energy head is the elevation of the water surface plus the velocity head at that point. The slope of the energy gradient represents all heat losses by friction, impact and eddies. It is important, therefore, to determine the energy gradient simultaneously with the surface slope. The process of applying the foregoing principles is best illustrated by a concrete example.

Fig. 1 is a typical cross-section of a river with curves of the hydraulic elements necessary for backwater computations. It is only necessary to plot curves of friction slope and velocity head. To determine these curves, however, it is necessary to compute areas, perimeters and hydraulic radii for the range of elevations involved.

Table I shows the computations necessary for determining the hydraulic elements of this section.

Areas—Cross-sections along the river shown in Fig. 1 were taken at low water by soundings from a boat, and the bank developed by hand level. The water surface elevation was determined at the time and the area for that elevation computed from the soundings. After plotting the cross-section, widths are scaled off at uniform intervals of elevation if the section is fairly regular, or at varying intervals if irregular.

From the column of widths, area increments are

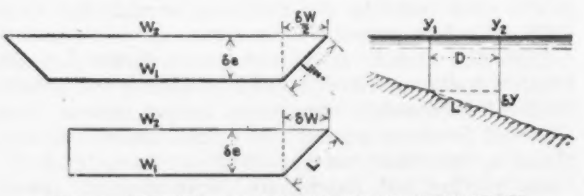


FIG. 2—METHOD OF DETERMINING PERIMETER

determined. The areas are then computed by adding successively these increments to the low water area.

Perimeter—The usual method of measuring the perimeter from cross-sections plotted to a natural scale is cumbersome. The following method has distinct advantages where soundings are taken at uniform intervals and is well within the limit of accuracy required. From the notation in Fig. 2 (at right) it is evident that

$$L^2 - D^2 = (\delta y)^2$$
$$(L - D)(L + D) = (\delta y)^2$$
$$L - D = \frac{(\delta y)^2}{L + D} = \frac{(\delta y)^2}{2D}$$

nearly. Hence if P is the total perimeter and W is the surface width,

$$P = \Sigma L = W + \frac{1}{2D} \Sigma (\delta y)^2$$

From the soundings taken at low water set down the differences in consecutive depths, square these differences and divide their sum by twice the common interval between soundings. The quotient is the amount to be added to the width to obtain the perimeter. Where the interval between soundings is not uniform treat each trapezoid separately.

Fig. 2 also shows how the same method is used to find the perimeter increments for successive increments of elevations in terms of width increments. In one case it is assumed that the increment to width is equally divided at each bank, and in the other that the increment is all at one bank. For given increments of elevations each assumption results in the following formulas:

δe	*First Case*	*Second Case*
1	$\delta P = \delta W + \frac{2}{\delta W}$	$\delta P = \delta W + \frac{1}{2\delta W} + 1$
2	$\delta P = \delta W + \frac{8}{\delta W}$	$\delta P = \delta W + \frac{2}{\delta W} + 2$
3	$\delta P = \delta W + \frac{18}{\delta W}$	$\delta P = \delta W + \frac{4.5}{\delta W} + 3$

The increments in perimeter corresponding to the increments in width are readily determined by slide rule and inspection of the cross-section. These increments are then added successively to the perimeter first ascertained from the soundings.

The hydraulic radii are then read directly by slide rule, i.e. area divided by perimeter.

All the above are dimensional functions of the cross-section and are independent of the flow, but the backwater curve is primarily a function of discharge which must be known in advance.

For the example cited the actual slope of the water surface was ascertained by a series of gages distributed over an 8-mile stretch of river (one of which was a recording gage) observed at the peak of a moderate freshet of 86,000 sec.-ft. discharge. It was then desired to extend the surface curves up and downstream from a known elevation at one of the gages for discharges of 109,000 and 136,000 sec.-ft. respectively. The n coefficient in Kutter's formula was first ascertained for 86,000 sec.-ft., using the known slopes. The value between each section was computed, eliminating the effect of velocity changes and eddy losses. The average value of n for the entire stretch of river was then used to compute the friction slopes at each section for various elevations and for the other discharges. These friction slopes are then plotted as shown by the curves, Fig. 1. The Kutter C varies somewhat with the slope, but the slope may generally be closely enough approximated in advance so that the value of C is within 2 or 3 per cent of its true value. If the final slope shows an error in C greater than this, the friction slopes should be revised and the computations repeated. For this reason it is best to leave the friction slope curves in pencil until the backwater computations are complete.

TABLE II—FLOOD SLOPE FOR DISCHARGE OF 136,000 SEC.-FT.

(1) Section	(2) Dist.	(3) Friction at Section	(4) Slope Average	(5) F	(6) k	(7) δh	(8) i	(9) $F+\delta h+i$	(10) e	(11) $F+i$	(12) E
130 + 50	1,900	0.00084			1.00				743.50		744.50
158 + 00	2,750	0.00117	0.00110	3.03	1.20	—0.20	0.10	2.93	46.43	3.13	47.63
175 + 50	1,750	0.00105	0.00111	1.94	1.20	0	0	1.94	48.37	1.94	49.57
197 + 50	2,200	0.00150	0.00127	2.79	1.78	—0.58	.29	2.50	50.87	3.08	52.65
211 + 00	1,350	0.00095	0.00122	1.65	1.30	0.48	0	2.13	53.00	1.65	54.30
222 + 00	1,100	0.00100	0.00097	1.07	1.10	0.20	0	1.27	54.27	1.07	55.37
237 + 00	1,500	0.00083	0.00091	1.37	0.95	0.15	0	1.52	55.79	1.37	56.74
246 + 50	950	0.00067	0.00075	0.71	0.67	0.28	0	0.99	56.78	0.71	57.45
260 + 50	1,400	0.00150	0.00108	1.51	1.05	—0.38	0.19	1.32	58.10	1.70	59.15
273 + 00	1,250	0.00115	0.00130	1.63	1.30	—0.25	0.12	1.50	59.60	1.75	60.90
280 + 50	750	0.00115	0.00115	1.00	1.33	—0.03	0.01	0.98	60.58	1.01	61.91
293 + 00	1,250	0.00096	0.00105	1.31	1.34	—0.01	0	1.30	61.88	1.31	63.22
310 + 00	1,700	0.00135	0.00116	1.97	1.72	—0.38	0.19	1.78	63.66	2.16	65.38
332 + 50	2,250	0.00086	0.00111	2.50	1.25	0.47	0	2.97	66.63	2.50	67.88
354 + 50	2,200	0.00108	0.00097	2.13	1.40	—0.15	0.07	2.05	68.68	2.20	70.08
380 + 50	2,600	0.00097	0.00102	2.65	1.49	—0.09	0.04	2.60	71.28	2.69	72.77
397 + 00	1,650	0.00106	0.00102	1.68	1.06	0.43	0	2.11	73.39	1.68	74.45
414 + 50	1,750	0.00114	0.00110	1.93	1.56	—0.50	0.25	1.68	75.07	2.18	76.63

The values of mean velocity are determined by dividing the discharges by the areas, and the corresponding velocity heads are set down from tables or by the use of the slide rule. After plotting the velocity heads for each section the backwater curve is computed.

Table II shows the computations for 136,000 sec.-ft. starting at section 130 + 50 and computing upstream. In the table, column

(1) designates the location of each section by station distances from some point of reference, in this case the mouth of the river;

(2) gives the distances in feet between sections;

(3) gives friction slopes read from the curves for elevations shown in column 10;

(4) average slope between sections;

(5) total fall due to friction between sections, i.e., product of columns 2 and 4;

(6) velocity heads read from the curves for elevations in 10;

(7) difference of velocity heads between sections;

(8) eddy losses which may vary according to judgment from 20 to 100 per cent of the change in velocity head when velocities decrease downstream. In this case eddy losses were taken at 50 per cent of negative change in velocity head, and zero for positive changes;

(9) Sum of columns 5, 6, and 8. This shows the total drop in the water surface between sections due to friction, velocity change, and eddy losses;

(10) elevations of the water surface;

(11) sum of columns 5 and 8. This shows the drop in the energy gradient between sections due to friction and eddy losses;

(12) elevations of the energy gradient, i.e., sum of columns 6 and 10.

The process of computation is by trial and error. The elevation of water surface at section 130 + 50 is known in advance to be 743.50. The water elevation for the next section 158 + 00 is assumed. The values of friction slope and velocity head are read from the curves for the assumed elevation. The fall F is computed from the average slope and the distance between sections.

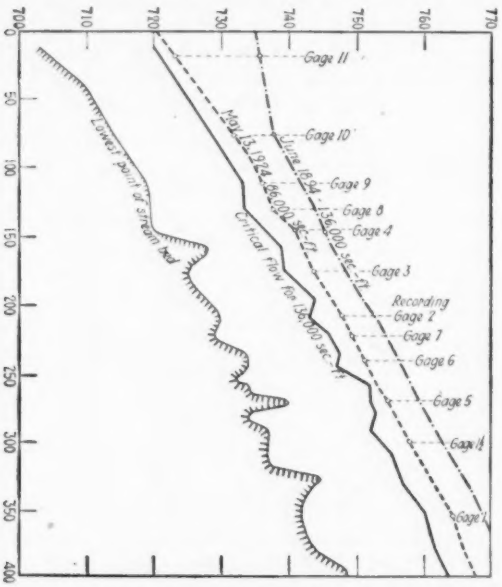


FIG. 3—SURFACE CURVES AND CRITICAL FLOW

The difference of velocity head is then set down. In this case the difference is negative downstream; hence half of it is considered as an eddy loss, which is set down in column 8. The sums of columns 5, 7, and 8 are then set down in column 9 and this sum is added to the known elevation at section 130 + 50. If the resulting elevation does not agree with the assumed elevation for section 158 + 00 another elevation very near the one so found is used and new values of friction slope and velocity head are read from the curves.

It is best to keep the trial computations on a separate slip of paper until the assumed and computed water elevations agree. The correct value can generally be found on the second trial, after a little practice.

After a correct water elevation is found for section 158 + 50 the sum of friction and eddy losses is added to the energy head at 130 + 50 to obtain the energy head at 158 + 00. This must check with the sum of water elevation and velocity head at 158 + 00. If it does not, an arithmetical error has been made.

After the correct elevations for water and energy head have been found for one section, those for each succeeding section are found in the same manner. The resulting surface curve is shown in Fig. 3.

The computations may obviously be made either up or downstream with equal facility. If each value is plotted progressively as found, it will aid greatly in selecting the trial elevation for the next section.

Whenever the flow is near the critical it is well to plot the line of critical flow for each section on the profile, as shown in Fig. 3. This is readily determined by adding elevations and velocity heads from the curves for each section until a minimum value is found. The elevation corresponding to this minimum value is that of the critical flow. In this case the surface curve is well above the critical flow.

If the surface curve crosses the line of critical flow a hydraulic jump must occur at some point downstream ("The Hydraulic Jump and Critical Depth in the Design of Hydraulic Structures," by Julian Hinds, *Engineering News-Record*, Nov. 25, 1920). The method herein outlined is equally applicable to flow above, or below the critical. As a jump, however, a sudden drop in the energy head due to impact and eddy losses must be allowed. The energy lost in the hydraulic jump was discussed by the writer in *Engineering News-Record*, June 4, 1925, p. 928, and is given by the expression

$$i = \frac{(y_2 - y_1)^3}{4y_2y_1}$$

in which i is the energy head lost by eddies and impact, and y_1 and y_2 the depths just before and after the jump.

The More Unusual Gases Occurring In Imhoff Tanks

Hydrogen Absent at Plainfield and Hydrogen Sulphide Found in But One Tank—Hydrogen Absorbed by Sludge in Experiments

BY F. L. CAMPBELL AND WILLEM RUDOLFS
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Paper No. 201 of the Journal Series, New Jersey Agricultural Experiment Stations and New Jersey State Department of Health, Substation, Sewage Investigations.

THE USUAL composition of Imhoff tank gases is now well known, and the limits of variations of the three principal gases, carbon dioxide, methane, and nitrogen, are fairly well defined. This paper describes some studies on the occurrence of the unusual gases, hydrogen and hydrogen sulphide, from Imhoff tanks at the joint sewage-works of Plainfield, N. J., and relates the beginning of an intensive study of the chemical and physical properties of sludge.

Dr. Imhoff in a very interesting paper on Imhoff tank gases (*Engineering News-Record*, Sept. 27, 1923, p. 512) presents some conclusions and states that hydrogen is found only in gas from tanks in the first stages of operation. No mention is made of whether or not the tanks in which hydrogen was found were seeded with old sludge. He also remarks that hydrogen may appear when there are disturbances in tank operation. This statement suggests that the detection of hydrogen as an indicator of abnormal, and, perhaps, undesirable digestion may be important.

At Plainfield, where Imhoff tanks are not considered to be functioning properly, at least fifty analyses extending over a period of two years have failed to reveal the presence of hydrogen in gas from any tank at any time. Hydrogen, then, does not appear as the result of every disturbance in tank operation. It was thought that a particularly favorable time had arrived for the detection of hydrogen, when a tank which had been emptied for alterations was put into operation in the spring of 1924. The bottom of the tank was covered with 30 in. of old sludge before sewage was admitted. Analyses made at frequent intervals after the tank was put into operation failed to show the presence of any hydrogen in the gases evolved. It appears that here an exception must be made to Dr. Imhoff's generalization that hydrogen appears in the first stages of tank

operation. It was thought that an error inherent in combustion analyses might account for our failure to find even traces of hydrogen. Consequently the combustion analyses were checked by the use of a direct absorption reagent for hydrogen, palladium chloride solution as proposed by E. D. Campbell and E. B. Hart (*Am. Chem. Jour.*, vol. 18, p. 294). No hydrogen was found.

In the paper already referred to, Dr. Imhoff attributed the usual absence of hydrogen in gas issuing from normal tanks to the combination of hydrogen, as soon as formed by bacterial action, with carbon dioxide to form methane and water. Since no mention of quantitative experiments was made, one might assume that this explanation is a hypothesis; and to us it seems an unlikely one, because the reaction is endothermic, and probably would not take place at ordinary temperatures.

TABLE I—ILLUSTRATIONS OF THE COMBINATION OF HYDROGEN WITH IMHOFF TANK SLUDGE

Exp. No.	Pipette With	Time Between Closing and Opening Pipettes Hours	Quantity of Gas at Start C.C.	Quantity of Gas at End C.C.	Hydrogen Lost Per Cent	Per Cent Composition of Gas at End of Experiments CO_2	O_2	CH_4	N_2	H_2
1	Water	2.2	20.7	20.4	4.6	....	1.0	....	3.6	95.4
	Sludge	2.2	....	4.7	....	19.0	0.0	72.0	9.0	0.0
	Sludge and H_2	3.2	19.9	27.1	19.6	19.5	0.4	16.6	4.8	58.7
2	Water	21.0	21.0	20.7	14.5	....	2.7	....	11.2	86.1
	Sludge	21.5	....	26.3	....	20.2	0.0	73.7	6.1	0.0
	Sludge and H_2	22.5	21.0	29.4	100.0	18.1	0.0	69.9	12.0	0.0

Hydrogen and Sludge—When we had satisfied ourselves that hydrogen does not occur in gases from the Plainfield tanks, we attempted to repeat Dr. Imhoff's work on the disappearance of hydrogen in sludge in a more nearly quantitative manner, to find out definitely whether hydrogen will combine with sludge, and whether this combination is physical or chemical in nature. A known volume of hydrogen was brought in contact with sludge in a Hempel single gas pipette and a pipette filled with water, and hydrogen was used as a first check. The results of two complete experiments are shown in Table I. A comparison of the percentage of hydrogen lost in the water pipette and in the sludge pipette shows the larger percentage lost in the latter. In the second experiment all of the hydrogen in the sludge pipette disappeared, while 85.5 per cent remained in the water pipette.

In the first experiment the ratio between carbon dioxide and methane in the sludge pipette is a usual one, 0.26 volumes of CO_2 to 1 volume CH_4; in the sludge-plus-hydrogen pipette it is 1.17 volume CO_2 to 1 volume CH_4. That is to say, the percentage of carbon dioxide in the latter is much higher than one would expect. It is natural to suspect that some chemical combination of hydrogen with sludge is responsible for the relative increase in the percentage of gas absorbed by sodium hydroxide. If chemical combination does take place, Dr. Imhoff's equation $4\ H_2 + CO_2 = CH_4 + 2\ H_2O$, which calls for a relative increase in the percentage of methane, will not fit the facts. The results were checked in another experiment.

TABLE II—BEHAVIOR OF HYDROGEN IN CONTACT WITH STERILE SLUDGE

Pipette With	Time Between Opening and Closing Pipettes, Hours	H_2 Introduced C.C.	Gas at End C.C.	H_2 Lost, Per Cent	Per Cent Composition of Gas at End of Experiments CO_2	O_2	CH_4	N_2	H_2
1. Sterile water+H_2	16	26.2	26.4	.....	0.0	1.13	.....	.....	.....
2. Sludge	16	....	66.1	.....	16.3	1.33	.....	.....	0.0
3. Sludge+H_2	20	24.9	126.9	97.09	14.5	0.0	58.4	24.19	2.91
4. Sterile sludge+H_2	22	24.8	24.1	2.83	0.0	0.83	0.0	11.07	88.1

After the pipettes stood for 22 hours, and all the hydrogen disappeared from the sludge-plus-hydrogen pipette, the ratio was found to be normal again.

The experiments were then repeated with hydrogen in contact with sterile water and H_2 plus sterilized sludge. The results are given in Table II. It is clear that practically no hydrogen disappeared when brought in contact with sterilized sludge for a period of 20 hours. This leaves two questions open before a definite answer can be given on the disappearance of hydrogen, if formed in tanks: (1) Alteration of the character of sludge by sterilization and (2) the presence of a bacterial catalyst. There is no doubt that, aside from possible chemical rearrangements of the sludge aggregate, a change in the physical character of the sludge took place; colloidal material seemed to have partially flocked out. Detailed studies are now under way to determine whether or not the disappearance of hydrogen is due to chemical combination, absorption or to a catalytic action of living organisms. A more complete description of the methods used and further discussion will be published later.

Hydrogen Sulphide—Hydrogen sulphide has been sought for qualitatively in gases from all of the Plainfield tanks, and has been found in but one of them; the tank already mentioned, which had been cleaned out for alterations and put into operation again. By the usual iodometric method, 0.1 per cent was found in gas from the new tank. The fact that hydrogen sulphide may or may not occur in gas from the same sewage seems to be evidence for the existence of different types of digestion within a single plant.

Other Unusual Gases—The usual chemical method of gas analysis is not sufficient for the identification of all the gases which theoretically might be evolved from Imhoff tanks. To test our assumption that Imhoff tank gas is usually a mixture of carbon dioxide, methane, and nitrogen, and, if possible, to detect the presence of other gases, the specific gravity of tank gas was determined with Schilling's apparatus in conjunction with chemical analyses. Examples of the results obtained are shown in Table III. The calculated values were obtained from the specific gravity figures 1.520, 0.553, and 0.970 for the three gases respectively. Correction was made for water vapor in the gas at a temperature of 25 deg. Centigrade.

TABLE III—COMPARISON OF SPECIFIC GRAVITY AND PERCENTAGE COMPOSITION OF IMHOFF TANK GASES
Determined by two methods to indicate the presence of unknown gases.

Analysis	Specific Gravity of Tank Gas	Specific Gravity of Tank Gas, CO_2	Percentage Composition of Gas CO_2	CH_4	N_2
1. Chemical	0.738*	0.585*	16.2	77.0	6.8
Schilling's apparatus	0.716	0.579	15.0*	79.7*	5.3*
2. Chemical	0.839*	0.571*	28.4	68.6	3.0
Schilling's apparatus	0.821	0.567	26.5*	70.8*	2.7*

* Calculated value.

In both examples specific gravities calculated from chemical results are significantly higher than those actually determined. Some other light gas, or gases, is indicated. A small percentage of hydrogen would account for the results, but we have shown that it is not present. The possibility of the presence of other hydrocarbons besides methane is excluded by these results.

Large Pier at Bremerton Navy Yard

A concrete "outfitting pier" is now under construction at the Bremerton Navy yard on Puget Sound Wash., which is 100 ft. wide and 1,200 ft. long, designed for live loads of 900 lb. per square foot in some parts and 1,200 lb. in others. The support consists of concrete cylinders cast monolithic with a bell-shaped base to fit over a pile cluster. Special foundation provision is being made where a 350-ton stiff-leg derrick is to be located. Alumina cement is being used for the outer 6-in of cylinder-and-base shell which are precast on a small timber wharf close to the pier. Forms are stripped and the shells can be placed within 24 hours after pouring. Standard cement is used in the concrete with which the shells are filled after being placed and anchored. Some of the cylinders are now in place and the entire job is scheduled for completion next year. The price was $1,187,000 under the contract awarded to Henry & McFee, Seattle.

Bridge Pier 228 Ft. High for Yosemite Valley Railroad

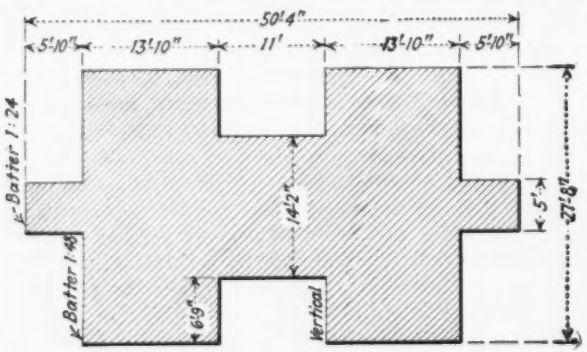
Seventeen-Mile Relocation Required by Exchequer Dam Includes Bridge Across Reservoir on Series of High Piers

THE area to be flooded by the Exchequer dam, now being built on the Merced River in California, includes several miles of the Yosemite Valley R.R., and in preparation for the impounding of water a section of the railroad 17 miles in length is being reconstructed at a higher elevation (as noted in an article on the Exchequer dam in *Engineering News-Record*, May 28, 1925, p. 880). About six miles above the dam, the new line will cross the reservoir on a steel bridge supported on concrete piers, which are now under construction.

The bridge will be 1,580 ft. long and will be composed of four continuous through spans, each 315 ft. in length, with four 80-ft. plate girders, one at the west end and three at the east. The heights of the five piers carrying the continuous spans are: Pier 1, 83 ft.; pier 2, 228 ft.; pier 3, 215 ft.; pier 4, 201 ft.; pier 5, 159 ft. The highest pier contains 5,930 cu.yd. of concrete.

The tall piers are all similarly designed, of the ordinary dumb-bell section, with square corners for convenience in formwork. The batter is variable, between 1 in 6 and 1 in 24 on the upper 60 ft. of the pier proper, and 1 in 48 on the lower part; the batter on the buttresses, which are centered on both ends of the pier, is 1 in 12 on the upper 60 ft. and 1 in 24 on the lower part. Reinforcement is not used except in the 13 ft. at the top of the pier.

Special attention is given to concrete proportioning on this work and the mix is watched very closely. The basis on which the several grades of aggregate are combined and proportioned is a combination of the methods developed by Fuller, Talbot and Abrams. In the combination of three aggregates, Abrams' fineness modulus principle is used with Talbot's grading equation; the Fuller graph is used similarly when found advantageous. Sand is measured by the inundation method, water is carefully controlled and the bulking

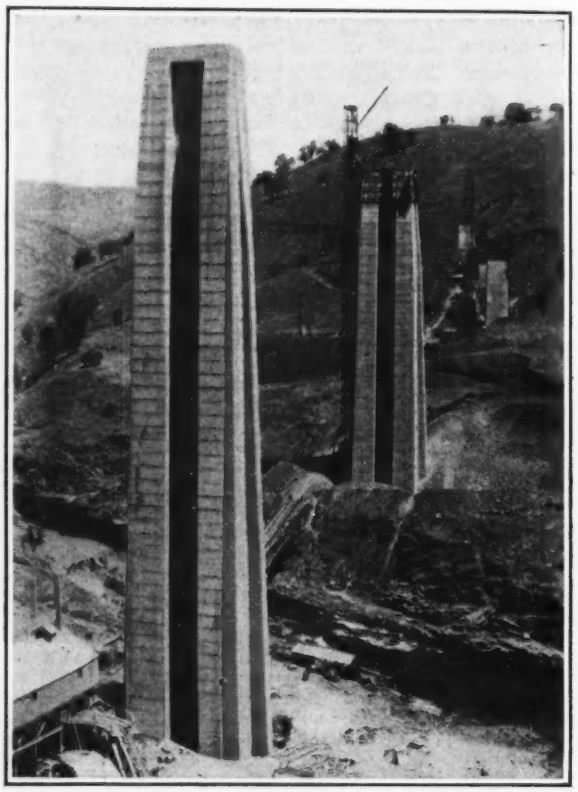


PLAN SHOWING DIMENSIONS AT BASE OF TALLEST PIER

of the aggregates is corrected in accordance with the results of daily tests. Close inspection is maintained, slump tests are made frequently and compression test specimens taken daily.

The result has been highly satisfactory as to quality of concrete. Requirements set up at the beginning of the work were that strength tests should show 2,000 lb. per sq.in. in pier footings, 2,500 lb. in the shaft, and 3,000 lb. in the caps, all with a 3-in. slump. Tests have shown strength averaging well above these.

The mixing plant, installed near the lowest point on the crossing, includes two 1-yd. mixers. From this point concrete is conveyed in 1-cu.yd. cars to the steel towers on which it is hoisted to the piers. Two of these towers are in use, and the work is scheduled so that one is always in service.



VIEW OF CROSSING, TALLEST PIER IN FOREGROUND

Wood forms are used, the panels being from 4 to 6 ft. wide. Panels are removed from the finished work only as needed for building up new sections above, and thus are handled only when transferred from one setting to the next. Workmen have to be roped while engaged on this formwork and not all members of the crews are willing to work on the outside of the piers after they attain considerable height.

The design for the piers was worked out by W. J. H. Fogelstrom, consulting engineer, under the general direction of Jerome Newman, consulting engineer for the Yosemite Valley R.R. J. A. Kitts is concrete technologist in charge of concrete proportioning and construction. The contract for the piers is held by Davis, Heller & Pearce, of Stockton, Calif.

Concrete Pipe for Telegraph Conduits

Concrete conduits are being successfully used in Australia for underground telegraph lines. Announcement has just been made that the postal and telegraph authorities of Australia have made a contract with the Hume Pipe Co., of their country, for 210 miles of 4-in. pipe for underground telegraph lines in Victoria, South Australia, and West Australia.

Some Records of Time Distribution in Road Building

Time Analysis on Road Just Finished and Three Built Three Years Ago—One Asphalt and Others Concrete—Weather Persistent Cause of Big Time Losses

COULD the road builder eliminate all other delays, states the author of one of the following articles, weather delays need not worry him. On the face of the figures given by this contributor and also those given in the companion article on the Absecon road, the statement appears to have support. Neither a poor pit requiring extra sorting of the gravel nor freight embargos are, however, like the weather, invariable causes of delay. In occasional instances some other hampering condition may assume impressiveness but year in and year out it is snow or rain, or their offspring, mud, which tie up most often and for the longest time the road contractor's equipment and crews. Persistently these hindrances account for some 15 per cent of all his lost time. And he is no better equipped or organized this year to meet the situation than he was last year or the year before or in any year since modern paved road building practices have developed. —EDITOR.

Asphalt on Concrete

BY ALBERT A. MAHON
Engineer, Union Paving Co., Philadelphia, Pa.

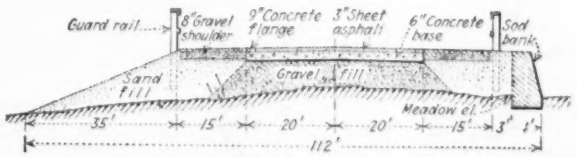
CONSTRUCTION last winter and this summer of a paved road on the Jersey coast afforded some interesting figures of delays. The road is known as the Absecon Boulevard. It extends 4.78 miles across the meadow land from Absecon to Atlantic City and is a sand fill of 3 to 4 ft. directly on the meadow land, topped with a layer of gravel. After the initial fill had been made, settlement was allowed to take place for approximately seven years when a contract was let to the company named for the construction of a permanent type of pavement as shown by one of the typical cross-sections, Fig. 1.

The order of construction was as follows: (1) The sod bulkheads, of which there was approximately 6¼ miles, had to be made to retain the sand fill. (2) The gravel embankment, approximately 53,000 cu.yd. of a variable fill of 1 to 3 ft., had to be made for the foundation of the base course, and as an inside barrier for the sand fill. (3) The sand fill had to be made either dry or hydraulically and then topped with an 8-in. layer of gravel.

Grading—Soon after the summer season abated in Atlantic City in September, 1924, work was started on the sod, gravel and sand embankment with two steam shovels and a fleet of 24 trucks supplying gravel; a large force of laborers cutting meadow sod for the bulkheads, and a hydraulic dredge pumping sand from the adjacent creeks for the sand fill. A record of delays and time worked in building grade is given by Table I, the basis being the total hours on the job and prepared for work.

Analyzing the items, No. 1 shows that actual production was taking place for only a little more than half the time we were on the job. No. 2 shows that the steam shovels were compelled to side-cast materials such as sand and top soil 12.8 per cent of their total time in order to obtain material, acceptable to the inspectors, for the road. No. 3 shows that rain prevented us from working 7.9 per cent of the time, which is a very low percentage. However, delay No. 4 is really the result of the previous item as the gravel, being naturally clayey, prevented trucks from getting out of the pits and across the first layers of gravel on the road.

Ordinarily, the sun is the contractor's best friend, but in item No. 5 it proved to be as great a menace as the other elements. Time after time when we organized for a good day's run on road gravel, the roads and pits being in a good, firm condition, due to the temperature dropping the previous night, the sun would thaw the roads and pits, making them impassable, thus shutting down the road graveling operation for the day. Delay No. 6 was a negligible quantity on this



Typical Roadway Section

Fig. 1

Two-Strip Concrete Base

Fig. 2

FIGS. 1 AND 2—SECTION OF GRADE AND PAVEMENT ON ABSECON ROAD

job, probably due to the salty nature of the soil and air; what little snow did fall was quickly dissipated. No. 7, however, was a real obstacle as we were seriously hampered by indecision and difference of opinion among the inspectors as to the quality of the road gravel, consequently we lost practically 20 days. Item No. 8 is composed of breakdowns of machinery, holidays and severe cold days.

In summarizing the road graveling, it should be said that it was long drawn out due to the fact that the gravel was not accepted by the results shown by a series of test holes, but by each individual load as it was loaded. Consequently we had to move an enormous amount of material to get the kind that was satisfactory to the state inspectors.

Base Construction—Because we encountered such great difficulty in securing suitable road gravel, we were prevented from starting the concrete base until

TABLE I—LOST TIME IN MAKING GRAVEL FILL

	Time	Hours	Per Cent
1	Worked on gravel embanment	1,202	57.4
2	Lost due to steam shovels side casting materials not acceptable to inspectors	268	12.8
3	Lost due to rain	165	7.9
4	Lost due to roads too wet to haul over	133	6.4
5	Lost due to sun thawing frozen roads	61	2.9
6	Lost due to snow	18	0.9
7	Lost due to shutdown by inspector	199.5	9.5
8	Miscellaneous delays	47.5	2.2
9	Total time	2,094.0	100.0

late in January, but the hauling conditions being so miserable at this time of the year, it was deemed advisable to continue the graveling until more suitable weather conditions prevailed. On March 31, 1925, we started pouring concrete; Table II shows the distribution of the time.

It is needless to explain the above items in detail as the same factors as those in Table I are involved. But it is well to note that we poured 109,027 sq.yd. of 6-in. plain concrete base 40 and 50 ft. wide in 45.25 ten-hour working days, or an average of 2,550 sq.yd. per day with two mixers. We had a series of exceptionally good days, on the best of which we poured 885 ft. of 40-ft. roadway or 3,933 sq.yd.

TABLE II—LOST TIME IN LAYING CONCRETE BASE

Time	Hours	Per Cent
Actually worked	452.5	76.9
Lost due to rain	46.5	7.9
Lost, too wet to haul	49.0	8.3
Lost, shutdown by inspector (lack of grade)	40.0	6.9
Total time	588.0	100.0

The concrete was poured for the full width of the roadway and we were enabled to tamp it by placing a 3x6-in. false form, as shown in Fig. 2, along the center line of the road, then lifting it out after the concrete was poured.

Asphalt Surface—Prevailing circumstances at the time we were constructing this job, together with the fact that it was possible to develop the sand for both the asphalt and the concrete on our prospective plant site, ruled that the asphalt and concrete plants be located at the same end of the job. Consequently upon completion of the concrete we were required by the specifications to wait until the last piece of concrete was two weeks old, before starting to lay the asphalt. So on June 11 the asphalt was started with one portable asphalt plant producing the mixed material, but at the instance of the county engineer, who was anxious to have the road open for the summer traffic, as soon as possible, another plant was set up, the same type as the first, and with one plant producing binder and the other top. Table III shows the distribution of time on the asphalt work.

TABLE III—LOST TIME LAYING ASPHALT

	Time	Hours	Per Cent
1	Worked on asphalt	456.5	82.5
2	Lost due to rain	78.0	14.1
3	Lost, miscellaneous (holidays, breakdowns)	19.0	3.4
4	Total time	553.5	100.0

The table is self explanatory, but in connection with Item 2 we were able to keep it as low as it is due to the freak nature of a number of rain storms. On numerous occasions it would rain on one part of the road and not the other, therefore we would shut down for a couple of hours and move a mile or two up the road and finish out the day's work, thus losing only a few hours.

We made very good progress on this work, averaging 3,000 sq.yd. of 3-in. pavement per day with two plants. Our best day's run was 4,400 sq.yd. of finished pavement in 13 hours.

In connection with this work, a very novel idea was introduced by J. F. Nourse on a day's work that did not meet with the approval of the county engineer. Due to the top surface being somewhat cold and to faulty raking, its finished condition was not satisfactory to the engineer. To obviate ripping up this pavement and replacing it, hot sand at a temperature of 600 deg. F. was applied to the surface, immediately swept off and thoroughly cross rolled. This obliterated all "honeycombs" and uneven conditions, giving the pavement a finished surface comparable to the balance of the road and satisfactory to the engineer.

The asphalt was finished on Aug. 6 and the following week on Aug. 15 the road was officially dedicated and opened to the general public. For the contractors the work was in charge of J. F. Nourse, district manager; A. A. Mahon, civil engineer; W. F. Reardon, superintendent, and W. L. Specht, assistant superintendent.

* * *

Straight Concrete Paving

By Crosby Tappan

Tyrone, Pa.

WHILE in charge of the construction of forty miles of concrete roads in 1922 I kept records of just what delays were caused by weather and what were caused by other conditions. I found that the weather has been blamed too much and that contractors can easily make up for time lost by bad weather through saving time lost in other ways. A brief resumé of my experience will illustrate this point.

At Trout Run, Pa., 49,814 ft. of concrete pavement 18 ft. wide and 6-8-6 in. thick was laid. In all, 203.5 days elapsed from when concreting started until it was finished. And 67 days were lost from various causes leaving 136.5 days on which concrete was laid. Below are the causes for the lost days.

	Days		Days
Weather: rain, mud, cold	23	Lack of cement acct. embargo	9
Holidays and Sundays	21	Caught up on grade	7
Breakdowns	7	Total	67

At Blossburg, Pa., 55,169 ft. of 18-ft. pavement was laid. There were 208 days elapsed time, of which 83 were lost for the following reasons:

	Days		Days
Weather	35.5	Strikes	5.5
Holidays and Sundays	6	Shut down by inspector	1.5
Breakdowns	1.5	Accident to mixer operator	0.5
Freight embargo	24	Moving mixer	3
Transportation failures	5.5	Total	83

At Franklin 26,752 ft. of 18-ft. pavement was laid in 126 days elapsed time; 46 days were lost due to:

	Days		Days
Weather	13.5	Paving an intersection	1
Holidays and Sundays	14	Moving mixer and plant	7.5
Breakdowns	2	Total	46
Freight embargo	8		

Analyzing these figures the following is got:

	Days	Per Cent of Total Time
Total lost time on the three jobs	196	
Lost because of weather	72	37
holidays and Sundays	41	21
breakdowns	10.5	5
embargo	41	21
moving plant	10.5	5
strikes	5.5	3
transportation failures	5.5	3
trouble with engineers		
trouble with inspectors	9.5	5
accident	0.5	..

With the exception of the embargo and the weather all these lost days could have been saved. If the embargo is left out of the total there are 155 days lost. Weather was the cause of 46 per cent of these lost days. If road builders keep the other 54 per cent from interference they should not worry about the weather.

Construction Notes on Texas University Stadium

Concrete Structure of Two Rectangular Sections—Rapid Building a Feature—Experiments in Concrete Mixtures

By A. T. Granger
Adjunct Professor of Civil Engineering, University of Texas, Austin, Texas

THE FIRST unit of the Texas memorial stadium, recently completed on the campus of the University of Texas at Austin, is a reinforced-concrete structure providing seats for 27,000 spectators. The stadium was built primarily for football and track, the football field being surrounded with a quarter-mile running track with a 220-yd. straightaway on one side.

The best available site was on the east slope of a creek. In order to form the playing field excavation was carried back into the hillside and the excavated material filled in on the creek side. The stand on the east, or uphill, side consequently has a maximum height of about 25 ft. above the ground line, while the corresponding height on the west side is 60 ft. For this reason a different construction was adopted for each of the two sides.

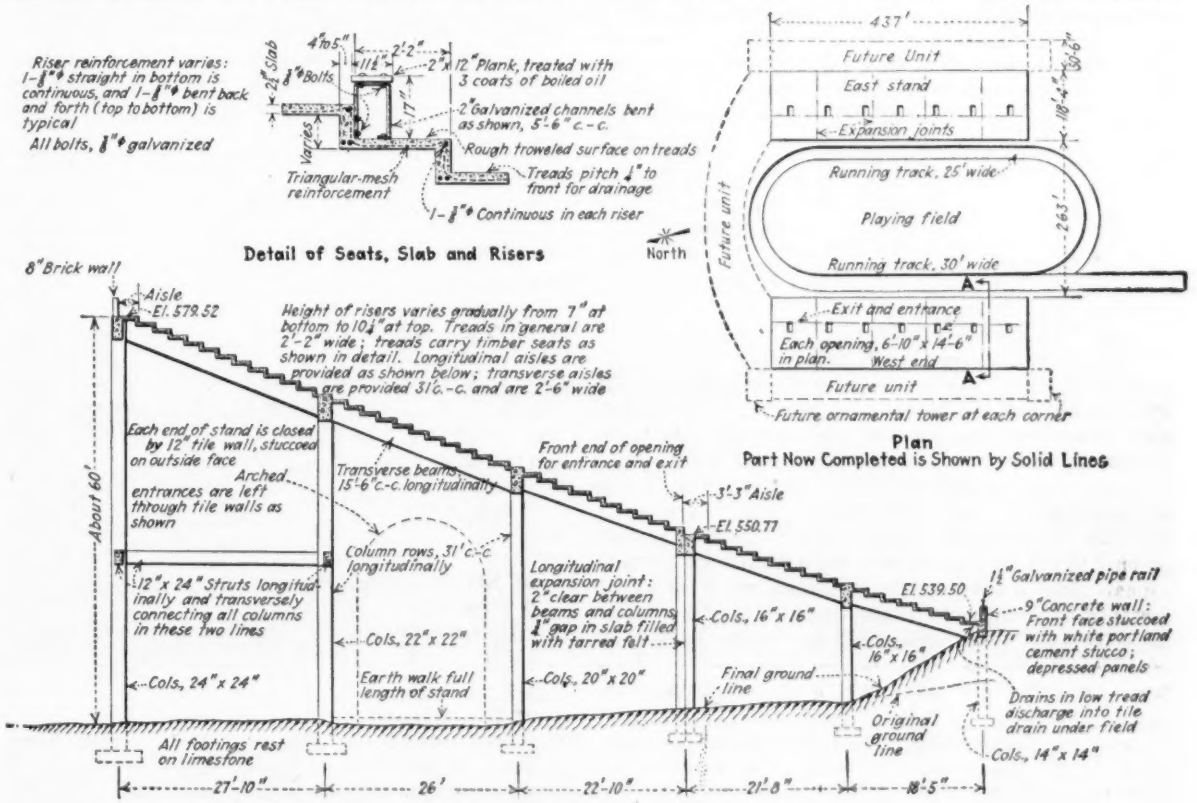
The concrete structure consists of a rectangular section on each side of the arena, each section being 118 ft. x 437 ft. in plan. The seats consist of 2 x 12-in. timbers bolted to galvanized channels bent to form inverted U-shaped standards, which are spaced on about 5½-ft. centers and supported by the concrete slab and risers. Aside from the seats, each stand is essentially a flight of concrete steps, there being 52 treads 2 ft. 2 in. wide and 437 ft. long, with risers varying from 7 in. at the bottom to 10 in. at the top of the stands, thus giving a concave upward curve. The treads are 2½-in. concrete slabs reinforced with 0.08 galvanized triangle mesh to span the 2 ft. 2 in. distance between the risers.

The risers are reinforced-concrete beams of a span of about 15 ft. and resting at the ends on heavy inclined beams running transversely. In the east stand each of these inclined beams is supported directly on a line of columns. To reduce the number of columns in the west stand, because of its greater height, every other inclined beam rests on a row of columns, while the alternate beams frame at their ends into horizontal longitudinal beams spanning the distance between lines of columns.

Exit and entrance are provided by seven openings in each stand connecting with the necessary ramps and stairways. The construction is reinforced concrete throughout, no structural steel being used.

All columns have spread footings resting on limestone rock. Although some of the holes were over 20 ft. deep, it was seldom necessary to resort to sheeting. Considerable water was encountered on the west side but by means of pumps could be lowered enough to permit concreting without resorting to the use of a tremie.

For various reasons it was considered absolutely essential to have construction sufficiently far advanced by Thanksgiving, 1924, to permit playing the annual


Riser reinforcement varies: 1-⅜" ϕ straight in bottom is continuous, and 1-⅜" ϕ bent back and forth (top to bottom) is typical
All bolts, ⅜" ϕ galvanized
4" to 5"
2'-2"
2½" Slab
⅜" ϕ Bolts
11½"
17"
Varies
2" x 12" Plank, treated with 3 coats of boiled oil
2" Galvanized channels bent as shown, 5'-6" c.-c.
Rough troweled surface on treads
Treads pitch ¼" to front for drainage
Triangular-mesh reinforcement
1-⅜" ϕ Continuous in each riser
Detail of Seats, Slab and Risers
437'
Future Unit
East stand
Expansion joints
118'-4"
50'-6"
Running track, 25' wide
Playing field
263'
Future unit
Running track, 30' wide
Exit and entrance
Each opening, 6'-10" x 14'-6" in plan.
West end
Future unit
Future ornamental tower at each corner
North
Plan
Part Now Completed is Shown by Solid Lines
8" Brick wall
Aisle
El. 579.52
Height of risers varies gradually from 7" at bottom to 10¼" at top. Treads in general are 2'-2" wide; treads carry timber seats as shown in detail. Longitudinal aisles are provided as shown below; transverse aisles are provided 31' c.-c. and are 2'-6" wide
Each end of stand is closed by 12" tile wall, stuccoed on outside face
Arched entrances are left through tile walls as shown
About 60'
12" x 24" Struts longitudinally and transversely connecting all columns in these two lines
Column rows, 31' c.-c. longitudinally
Transverse beams 15'-6" c.-c. longitudinally
Front end of opening for entrance and exit
3'-3" Aisle
El. 550.77
Longitudinal expansion joint: 2" clear between beams and columns, 1" gap in slab filled with tarred felt
El. 539.50
1¼" Galvanized pipe rail
9" Concrete wall: Front face stuccoed with white portland cement stucco; depressed panels
Cols., 16" x 16"
Cols., 22" x 22"
Cols., 24" x 24"
Cols., 20" x 20"
Earth walk full length of stand
Final ground line
Drains in low tread discharge into tile drain under field
Original ground line
Cols., 14" x 14"
All footings rest on limestone
27'-10"
26'
22'-10"
21'-8"
18'-5"
Section A-A — Typical Transverse Section Through West Stand

PLAN, SECTION AND SEAT DETAILS

football classic between Texas University and Texas A. & M. College in the stadium. This was the principal factor which controlled construction. The contractor desired to use a central mixing plant and chute all concrete for both stands from a central tower; but to allow the playing field to be prepared simultaneously with the stands it was necessary to abandon this scheme and adopt a separate tower behind each stand, with a separate mixer for each. The north half of the superstructure was placed from the original position of the towers and they were then shifted near the south end, from which location all the remaining concrete was placed.

Specifications called for 1:2:4 concrete. The best available sand was very clean, hard, and well graded, except deficient in fine particles. The coarse aggregate originally employed was a hard washed limestone gravel graded from ¾ in. to 1 in., the particles larger than 1 in. being crushed and put back with the gravel. Consequently, the coarse aggregate was a combination of gravel and broken stone. These two aggregates when mixed in the proportion 1:2:4 gave a very harsh, rough concrete which did not flow well in the chutes nor work well in the forms. It was, furthermore, very difficult to secure 2,000-lb. concrete, as tests of the concrete showed.

After some experimenting the mixture was changed to about 1:2⅝:3¼ for the most of the work with very beneficial results as to workability, and some apparent increase in strength. However, the continued difficulty of securing 2,000-lb. concrete finally led to the abandonment of the original coarse aggregate, which on close investigation appeared to have a thin calcareous coating tightly adhering to each particle which could not be removed by ordinary commercial washing. The coarse aggregate then adopted was a smooth siliceous gravel from the Colorado River which gave greatly improved strength. It seemed desirable however, to continue the 1:2⅝:3¼ mix.

Each stand is divided by one longitudinal and four transverse expansion joints into ten sections, each of which was completed in one pour. The largest contained about 240 yd. of concrete which was placed in fourteen hours, using a 3-sack mixer. The outstanding construction feature was probably speed of erection. The first ground was broken about June 15 and the structure was practically completed by Nov. 27, accommodating the crowd for the Thanksgiving game. It contains about 3,800 yd. of concrete and 320 tons of reinforcing steel, and total cost was approximately $235,000.

The Herbert M. Greene Co. of Dallas, were the architects, and Walsh & Burney, of San Antonio, the contractors, with A. A. Hasbrook as their field superintendent. The writer was supervising engineer for the Stadium Association.

CONCRETE STANDS AT UNIVERSITY OF TEXAS

Urban Highway Finance Under Investigation

Announcement is made by Charles M. Upham, director, Highway Research Board of the National Research Council, of the commencement of a new investigation on the urban highway finance problem. Jacob Viner, professor of government finance at the University of Chicago and a consulting expert on finance problems, has been selected to conduct this investigation. The objects of this study are: to determine the relation of city dwellers to the rural finance problem; to investigate the problems of city street finance including the financial problems of construction, maintenance and widening of city streets; and to study the financial aspects of city traffic control. Prof. Viner is a graduate of McGill and Harvard Universities and was formerly with the U. S. Tariff Commission. In addition to his duties at the University of Chicago he is chairman of the highway finance committee of the National Tax Association, which presented a comprehensive report at its 1924 meeting. He is also secretary of the revenue and taxation committee of the Chicago City Club, and is a member of the Chicago civic committee on the reform of the Illinois tax system. The report on this investigation will be presented at the fifth annual meeting of the Highway Research Board to be held in Washington, D. C., Dec. 3 and 4, 1925.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

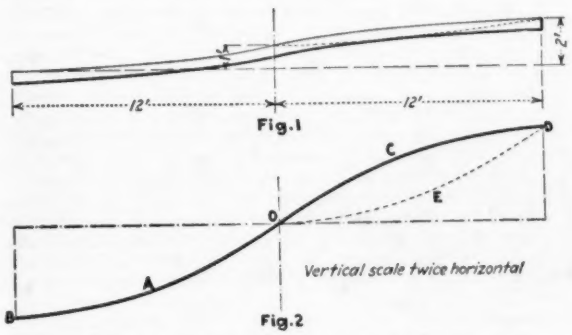
Designing Banked Highway Curves for Safety

Sir—I have recently received the issue of *Engineering News-Record* of Aug. 20, and have read with some interest C. J. Myers' article on p. 303, giving an account of the double parabolic type of profile which he has developed for road surfaces on curves. Taking the profile *B* which he shows in Fig. 1 of his article, in which there is a rise of 12 in. in the 12 ft. half-width of the road, the slope to the tangent of the profile curve ranges from zero to $\frac{1}{6}$, the equation of the curve, taking the axes of co-ordinates through the lowest point, being

$$Y = \frac{x^2}{144}$$

As Mr. Myers states in his article, the average vehicle having a 5-ft. width of tread will get a bank of $1\frac{1}{2}$ in. per foot when running on the steepest part of the curve, whereas the slow moving vehicle running close to the haunch of the road will be canted only a little over $\frac{3}{4}$ in. per foot.

When Mr. Myers extends his scheme to the ordinary two-way road he has, for some reason which is not given



PARABOLIC BANKED HIGHWAY SURFACE

in the article, merely duplicated his one-way track. This results in a profile which has a defined ridge at the center and might hardly be expected to wear well in practice. It appears to the writer that a considerable improvement might be made by reversing the second parabola in the way shown in the accompanying Fig. 1. The profile is plotted to an exaggerated scale in Fig. 2, where the dotted line *OED* is Mr. Myers' curve, $Y = \frac{x^2}{144}$, *BAO* is a repetition of this curve in which the point *O* is shifted to *B* and *D* to *O*. *OCD* is an inverted curve obtained by rotating *OAB* clockwise through two right angles. The complete curve *BAOCD* gives a continuous smooth profile since *BAO* and *DCO* have a common tangent at *O*. In the ordinary way slow moving traffic keeps to the sides of the road and fast traffic passes along the center. With the profiles shown in Fig. 2 this is allowed for since the slopes of the curve are zero at *B* and *D* and a maximum at *O*. This is in contrast with Mr. Myers' profile in which, on the left-hand section, fast traffic should be near the center of the road and slow traffic at the side and on his right-hand section the slow traffic will be near the center of the road and the fast traffic at the sides. This is a state of affairs which can lead only to confusion and accident.

The profile shown in Fig. 2 has a further advantage when a single line of fast moving vehicles is considered. A steeper effective bank can be obtained in this case by running the vehicles along the center of the road than it is possible to obtain on Mr. Myers' profile. With a 6-ft. width of tread of which 2 ft. 6 in. is on either side of the center line, the effective bank is increased to $1\frac{3}{4}$ in. per foot as compared with $1\frac{1}{2}$ in. per foot which is the maximum with Mr. Myers' design.

Although the section shown in the article has an advantage in that a line is formed automatically on the surface separating the traffic in the two directions, it would appear better to have a smooth profile in which if necessary a line can be marked on in the ordinary way either by using a different color of concrete or otherwise.

Westminster, England, E. G. WALKER.
Sept. 4, 1925.

Earthquake Resistance of Buildings

Sir—The letter from Homer N. Hadley, of the Portland Cement Association, entitled "Some Observations on Structural Behavior in the Santa Barbara Earthquake," in your issue of Aug. 27, p. 358, appears at first sight to be a criticism of the writer's two articles on "Earthquake Damage to Santa Barbara Buildings" in *Engineering News-Record*, July 9 and July 23, pp. 68 and 149. On reading Mr. Hadley's comments carefully, however, the writer feels that Mr. Hadley's observations corroborate in general the writer's conclusions. It should be remembered that Mr. Hadley spent two weeks in examination of the buildings, at a time when there was no confusion, in contrast to the writer's two-day observation period in a time of stress, when authentic information as to detailed construction of buildings was most difficult to obtain.

There is no discrepancy in the writer's statements of direction of shock and the evidence of cracked walls. Mr. Hadley appears to be somewhat confused in thought with respect to the direction of shock. Let it be remembered that the vibrations of the elastic earthquake waves, which do the most damage to buildings, are the transverse vibrations, i.e., vibrations at right angles to the direction of propagation of the wave. Further, let it be remembered that the directions of the walls themselves fix the visible direction of these transverse waves, for the *X*-crack is the work of that component of the force which is parallel to the wall. The general *X*-cracking of walls normal to State St., the general absence of *X*-cracking in walls parallel to State St., and the throwing outward of walls parallel to State St., indicate that the transverse vibrations of the wave were nearly normal to State St. The direction of the longitudinal wave was nearly parallel to State St. The writer feels that it was this first longitudinal wave which threw down the San Marcos.

With reference to laitance joints as planes of weakness, and the observation that they usually occur at the junction of column and underside of floorbeam, there is no doubt but that these planes of weakness had their effect in locating the general cracking of reinforced-concrete columns. But the cause of the cracking was the combination of shear and bending due to the earthquake. It is not particularly reassuring to think that such planes of weakness are likely to exist in all reinforced-concrete columns, as Mr. Hadley says "thousands of similar columns (exist) elsewhere with laitance in the joints." Just what are the comparable weaknesses in "thousands of steel columns in which the intentions of the designers have been imperfectly carried out" is not stated. The writer believes that the omission to name such faults is important. The steel frame has one most important advantage over the reinforced-concrete frame. There is a practical certainty in structural-steel construction that the frame will be constructed as designed. On the other hand, with reinforced concrete only the most unrelenting, intelligent and continuous inspection will insure that the construction is as designed, as regards size of members, details of steel and quality of concrete.

The importance of walls in construction for resistance to earthquakes is to the point. The walls of a building must either be strong enough, with the structural frame into which they tie, to resist the forces that come upon them from the earthquake or they will suffer damage, varying from slight damage to complete destruction.

In the writer's opinion a building with a structural-steel frame and reinforced-concrete walls, both frame and walls

designed for resistance to the forces to be expected from an earthquake, is the highest type of construction; the all-reinforced-concrete building is second. The probable forces of the earthquake may be computed from known facts of foundation conditions, distance from known fault lines, and earthquake history. HENRY D. DEWELL.

San Francisco, Calif.
Sept. 10, 1925.

How to Plan District Water Supplies: A Rejoinder

Sir—Your editorial, "How to Plan District Water Supplies," in *Engineering News-Record*, Sept. 10, 1925, p. 414, would seem to call for some comment from the District Commission's standpoint lest the actual situation be somewhat misunderstood by the casual reader.

Your featuring of the North Jersey District Water Supply Commission as "the agent" of a "loose, riotous and recalcitrant partnership," hardly seems a fair designation of the situation in view of the very fine spirit of co-operation manifested by the municipalities of Newark, Paterson, Passaic, Clifton, Montclair, Glen Ridge and Bloomfield and, in view of their generous consideration of other municipalities shown on several occasions, it would appear that this partnership is on the contrary a *firm, orderly and willing* one.

That the Statute of 1916, under which the Water Commission is acting, is somewhat cumbersome may be true, but it has been found nowhere near as complicated in its actual execution as would appear from reading the text and it has been conclusively proved that *it works*. The wisdom and necessity of the legislation, it seems to me, cannot be justly criticised in view of the fact that the Act of 1902, creating the Passaic Valley Sewerage District and Commission, providing for district bonds, was declared unconstitutional, as well as the Act of 1907, providing for the issuance of bonds by the then State Water Supply Commission upon the security of its water-works properties. The legislation, starting in 1902, as you point out, and continuing to date, has been successively improved and the district water supply statute, as it stands today, with amendments, is, as might be expected, superior to the 1907 sewerage district statute in several respects; particularly in avoiding the possibility of there being "loose, riotous and recalcitrant" agreements. There is full authority in the law of 1916 for the Commission to provide water for future municipalities within the district, which may properly be supplied from the Wanaque system, providing there is such a supply available, and even though a single participating municipality should unreasonably refuse premission; but, as previously stated, the reasonable and even generous attitude of the participating municipalities, particularly the original participating municipality of Newark, gives no reason to believe that such a condition would arise, even though there may have been recently some friction among the municipalities in the sewer agreement.

I cannot agree with your statement, "It is time to stop loading all the blame on the New Jersey Constitution," and your reference to the State Constitution as a "bugaboo." It is no bugaboo. It is a plain, hard fact and one which the officials of the district and the legislatures of the state have had to face and I cannot agree with your statement that it "never has been squarely faced." It has been squarely faced by the legislature and, more than faced, it has been met, even though the resulting legislation may not agree with some academic theories of "sound governmental principles."

You are correct in your statement that "forty years ago New Jersey had a State Water Supply Commission" but you have omitted to state that this commission was superseded by another State Water Supply Commission in 1907 eighteen years ago, and that this commission for eight years "squarely faced" the water supply situation, trying to operate under a law authorizing the issuance of bonds. The commission of 1907 actually negotiated the purchase of a water-supply property, with the approval of Governor Woodrow Wilson, to be paid for by bonds of the commission backed by the credit of the state, but by a ruling of the attorney general and a verdict of the highest court of the state, it was decided that this expenditure could not be made without a referendum to the people of the *entire state*. Such a referendum for the purchase of the Wharton Tract, regarded by the then State Water Supply Commission as the most favorable project which could be put before the people of the state, in view of the fact that it had especial interest to the people in South Jersey, was lost in 1915 by a vote of 20,750, there being 123,789 votes against and 103,039 votes for the proposition. You have overlooked this occurrence in making your statement that "no referendum was ever invoked."

I am sure that *Engineering News-Record* has only a desire to help and not hinder in the development of needed water supplies and I have been personally assured by Clemens Herschel that that is his only desire in presenting the thoughts upon which you have commented, and I am sure that your statement that the adoption of one of several proposed plans "decades ago would have saved the people of northeastern New Jersey untold millions of water expenditures" is not meant to be any criticism of the execution of the Wanaque works under the North Jersey District Water Supply Commission, which has been carried on in a businesslike and economical manner and has not involved the expenditure of many "millions" of unnecessary funds. While I am sure that the editorial staff of *Engineering News-Record* understands this, I am not so sure that such thoughtless and easily misunderstood remarks—and in that category I would include "loose jointed," "recalcitrant," "riotous" and similar expressions—are likely to hinder rather than to help in the solution of the problem. I have already found that some earnest, public-spirited municipal officials have postponed reasonable, sound engineering programs due to their understanding from reading certain press articles that plans were afoot for the state to take over all water supplies, relieving the municipalities of their fundamental responsibility in the matter.

Never before in the history of the North Jersey District was a sound solution of the water-supply problem so near consummation. Besides the construction of the Wanaque project, already actively and sincerely supported by seven of the large and more influential municipalities, studies have been made for new developments for a municipality more conveniently and economically supplied from another source; inquiries and reports are under way for other municipalities who now see that the district scheme is workable and the whole district has within its grasp today a scheme by which every reasonable need may be provided for, and its execution will be greatly hindered by discussions of radical changes in legal procedure and comment indicating lack of confidence in the existing statutory and administrative machinery. ARTHUR H. PRATT,

Newark, N. J. Chief Engineer, North Jersey District
Sept. 24, 1925. Water Supply Commission.

[The editorial in question was country-wide in its bearing upon the recent and prospective formation of water-supply and sewerage districts. It was based on New Jersey experiences because the water-supply question in New Jersey is so acute and contentious that a special committee on state water supply was created by the 1925 legislature and is to submit a report next January, and because Clemens Herschel has recently submitted a state water plan to that committee, which was commended in the editorial as worthy of consideration not only in New Jersey but throughout the country.

It should be repeated, however, that the editorial comments were based on the governmental aspects of the North Jersey District Water Supply Commission and not on the commission or its engineering staff, and acknowledgment should be made that in framing the statutes creating the water-supply commission and defining its powers and the contractual relations between it and the municipalities concerned there has been an improvement over the similar legislation creating the sewerage commission mentioned in the editorial and that the picturesque language quoted from Mr. Herschel is less applicable to the water commission and its municipal clients than to the sewerage commission and its clients.

Nevertheless, this journal stands by its original pleading that prospective water and sewerage districts in other states look elsewhere than to New Jersey for model enabling acts.—EDITOR.]

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Correspondence School for Drafting Found Unfair

Federal Trade Commission Issues Desist Order Against Chicago Firm—Illegal Activities Listed

The Federal Trade Commission has issued a cease and desist order directing B. W. Cooke, C. E. Wesch, and Job-Way Home Study, Inc., all of Chicago, to discontinue certain business practices in connection with a correspondence course for drafting, which the commission found to be unfair methods of competition. The Job-Way Home Study, Inc., was incorporated in May, 1924, by respondent Cooke, who became its president and treasurer and practically its sole stockholder. Respondent Wesch was secretary of the company. The commission found that the respondents operated a correspondence school purporting to teach mechanical and other forms of drafting. It was found that in addition to the incorporated name, the respondents also operated under the following designations: "Coyne School of Drafting" and "Associated Drafting Engineers." Under such trade names, the findings state, the respondents through newspaper and other periodical advertisements, circulars and letters made many false and misleading statements in connection with the courses offered.

The commission's complete order gives in considerable detail all of the practices prohibited, specifically to this company, but generally applicable to all similar enterprises. The respondents were ordered to cease and desist from representing directly or indirectly: That they can and will in a period of ten months or less, by a correspondence course, qualify a pupil, even though he has had only a common school education, as an expert draftsman; that there is a demand for the services of persons trained by the respondents; that immediately upon the completion of the course of instruction in drafting that the pupil will obtain, or respondents will obtain for the pupil (in case of default in this particular they will return the pupil's money) a high and responsible position paying a salary ranging from $200 to $800 per month; that the respondents legally guarantee to their pupils either satisfaction or the return of money paid.

They were further ordered to cease representing the fact that there exists a powerful association of drafting engineers engaged in the practice of their profession and that the association is offering a course of instruction through the respondents; also that C. E. Wesch is the chief of staff of any such purported association, and that there is any association of drafting engineers engaged in the practice of their profession who offers pupils assistance and advice through the respondents, and which will, after the pupil has finished the course, use its influence to secure for the pupil employment at a large and lucrative salary.

They shall further not represent directly or indirectly that the courses of instruction offered by the respondent usually are given for a certain amount, but that by special rate the pupil will be allowed to take the courses for a smaller amount, when in fact the said smaller amount is the regular and usual rate paid for such courses; nor shall they promise to give free to the pupils tools, appliances and supplies, when in fact these are not given free, but are charged for and the amount is included in the price paid by the pupils for the course of instruction. They shall not send to pupils delinquent in paying the sums alleged to be due for these courses of instructions fictitious letters from collection agencies or other like documents purporting on their face to be legal.

Finally, the respondents were ordered to cease and desist from using and employing the name "Associated Drafting Engineers" as a trade name for the business of conducting a correspondence course in drafting; or using and employing any similar name likewise suggesting that the course is offered by an association of drafting engineers.

Engineering Fifty Years Ago

From *Engineering News*, October, 1875

NEW Line to the East.—By an arrangement between the Erie and Baltimore and Ohio railway companies a new and direct line from Chicago to New York has been established and through trains will commence to run over the line Nov. 1st. The Union of these two great companies is the result of the selfish policy of Commodore Vanderbilt in excluding the Pullman car from the roads owned and controlled by him. The new route will be fully equipped with Pullman cars of the most approved pattern and finish.

Financing Detroit River Bridge

According to information received by the Mayor of Windsor, Ontario, the syndicate of New York men which has been negotiating with councils of the border cities in connection with the proposal to construct a $12,000,000 bridge between Detroit and the Canadian shore of the Detroit river, will know in ninety days whether they are sufficiently interested to arrange for financing the project. If traffic possibilities and soundings of the river bottom indicate the bridge will be a paying proposition, the Canadian Government will be asked by the company to guarantee $5,000,000 in debentures to defray part of the cost of the construction.

Samuel Rea Retires as President of Pennsylvania System

Samuel Rea, after 54 years of active railroad life, has retired from the presidency of the Pennsylvania Railroad System, having reached his 70th year on Sept. 21. It is expected that W. W. Atterbury, a vice-president of the system who served as director-general of transportation with the American Expeditionary Force in France, will be appointed to the presidency.

Mr. Rea was born in Hollidaysburg, Pa., in 1855 and began work with the Pennsylvania as a chainman and rodman in 1871, leaving the railroad shortly afterward but rejoining it again in 1875 as an assistant engineer. From 1879 to 1883 he served as engineer in charge of surveys in Westmoreland County and of rebuilding of the Western Pennsylvania R.R. In the latter year he was transferred to Philadelphia as principal assistant engineer. In 1888 he was made assistant to the second vice-president. In 1889 he left the Pennsylvania R.R. going to the Baltimore & Ohio as vice-president of the Maryland Central Ry. Co., and chief engineer of the Baltimore Belt R.R. In 1891 he resigned this position on account of ill health and a year later re-entered the service of the Pennsylvania as assistant to the president. In 1912 he was elected president of the company.

Mr. Rea was elected an honorary member of the American Society of Civil Engineers in 1921.

RETIRING PRESIDENT OF PENNSYLVANIA R.R.

SAMUEL REA

Rock Island Plans to Build Line From Kansas Into Texas

The Chicago, Rock Island & Pacific Railway Co. has applied to the Interstate Commerce Commission for authority to build an extension from Liberal, Kan., across Oklahoma to Amarillo, Tex., a distance of approximately 145 miles.

Three Vote on City-Manager Plan

The city manager plan of government was adopted at Keansburg, N. J., on Sept. 29 by a vote of 393 to 332, with 75 per cent of the registered vote cast. On Sept. 22, the plan was rejected at Ocean City, N. J., 1,279 to 673. The plan was also rejected at Saco, Me., Sept. 13 by a vote of 1,360 to 746. In New Jersey there have been five rejections and two adoptions of the plan since the passage of the enabling act of 1923.

Report Progress on Pay-Increase Plan in New York City

The meeting on Sept. 28 of the engineers in the employ of the city of New York who have organized as the Association of Engineers of New York, and have inaugurated the movement to secure proper professional and pecuniary recognition, was addressed by J. T. Mahoney, justice Supreme Court; Harry B. Chambers, former commissioner of education; Alex Haring, professor of structural engineering, New York University; Kingsley E. Martin, chairman, metropolitan section of the A.S.M.E.; Dr. W. H. Schliffer, president Civic League of Brooklyn.

The association announces that 250 new members have been secured since the last meeting and that support of their plans is meeting with the hearty approval of all civic and professional associations that have been appealed to.

Concrete Reinforcing Steel Institute Meets at Chicago

On Sept. 23 the members of the concrete Reinforcing Steel Institute held a semi-annual meeting at Chicago. This recently organized trade association has offices at 160 N. La Salle St., Chicago. It intends to become a clearing house for information of interest to the industry. According to the reports at the recent meeting, it has gathered confidential statistics from its members and has published some confidential reports showing total tonnage of barrels shipped during the past five years, tonnage sold during the first six months of 1925 by districts, tonnage shipped from warehouses and mills for a similar period, and stocks on hand each month contrasted with normal supply. A group of cost experts in the membership has developed a simple uniform system of tabulating warehouse costs, which has gone into effect.

Port Authority Association Meets in New York

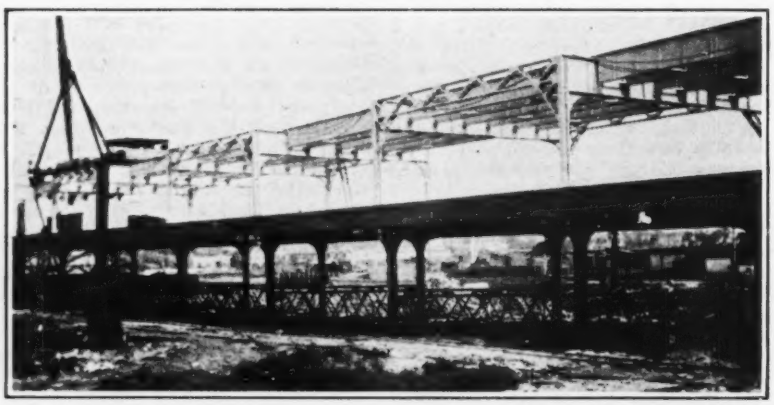
From Sept. 28 to Oct. 1 the 14th annual convention of the American Association of Port Authorities was held in New York City. The first day was devoted to a business session and to the discussion of papers, and on subsequent days, excursions were taken, first, around the city of New York in examination of the port facilities there, second, to the Newark Bay and the facilities in Port Newark, and third, to Coney Island and Jamaica Bay. In addition, a banquet was scheduled for Oct. 1, on board the International Mercantile Marine steamer Majestic at its pier in New York City.

Notice of the officers elected and the principal discussion are not available for this week's issue.

Asphalt Paving Schools Planned

At the fourth annual asphalt paving conference in Detroit Oct. 21-23 there will be considered a plan for the establishment of six or seven temporary schools in various parts of the country for training asphalt paving experts, the supply of which, it is felt, may otherwise fall below the demands occasioned by the rapid increase in the use of asphalt paving. The plan contemplates locating the schools so as to serve the peculiar needs of respective sections of country and to continue the course for one or two weeks at each school. The same faculty would serve each school.

Rapid Transit Extension at New York



Corona Line of the rapid transit system of New York being extended to Flushing on Long Island. The portion shown is the approach to the double-deck bascule bridge being built over the Flushing River. Roosevelt Ave. is to be carried on the lower deck over the Long Island R.R. tracks and the river, and the rapid transit line (three tracks) will be carried on the upper deck. The rapid transit line will go down into subway in Flushing.

Structural Engineers, Fabricators Discuss Bidding Methods

Reform of methods of preparing plans and asking bids for structural steelwork for buildings was discussed on Nov. 28 by structural engineers and fabricators of the New York district in a meeting called by the Structural Steel Board of Trade, a recently formed organization of fabricators and erectors. Charles L. Eidlitz, chairman of the Board, stated in introduction that the fabricators had suffered serious disadvantages and losses from the current practice of calling for pound-price bids on incomplete or sketchy plans, and had agreed to correct the evil condition by refusing to bid on such plans, this agreement to take effect Nov. 1. As it was recognized that such action would affect the engineers who design steel work, as well as their relations to their clients, the meeting was called for full interchange of opinion. It was desired to determine whether the engineers regarded the change as feasible and fair, and that degree of completeness of plans could fairly be expected at the bidding stage.

Engineers present replied that it was not generally possible to provide fully dimensioned plans at the time bids are called. The architect's plans are not sufficiently developed at that time, nor is enough information available on equipment and details. They conceded that the submission of sketch plans for bidding frequently misled the steelwork bidders. On this point a number of specific cases of disadvantage or loss to the contractor was cited by the fabricators. However, no concrete suggestions were offered as to the minimum degree of completeness of plans that would permit the dependable estimating for bids.

It was therefore finally decided by vote of the meeting that a committee of three engineers and three fabricators should be named "to prepare a statement as to what shall be considered essential in plan completion and detail to enable the fabricator to make an intelligent estimate and to provide a workable method for taking care of exceptional cases where these conditions cannot be complied with." Under this resolution the chairman appointed the following committee: engineers, H. G. Balcom, C. J. Jeppesen, S. F. Holtzman; fabricators, J. L. Hay, George Lund, Jacob Loewenstein. The committee plans to hold its first meeting Oct. 5.

State to Maintain "Unconstructed Roads" in California

The California Highway Commission is acquiring sites for new maintenance stations and is otherwise preparing to undertake extensive maintenance work beginning next January. This is in accordance with an action of the last legislature which specifically directed the commission to take over maintenance on unconstructed state highways. To date the state has acquired about 80 maintenance stations most of which have already been improved. According to an announcement by Harvey M. Toy, chairman of the commission, 200 or more such stations will be ultimately needed.

Niagara Falls Becomes Sole Owner of Water Systems

The city of Niagara Falls, N. Y., which for many years has been supplied from a municipally-owned and also from a privately-owned waterworks system took over the latter on Aug. 1. The private plant was owned by the Western New York Water Co., the manager of which is Henry F. Huy, president, American Water Works Association, Buffalo, N. Y. The sale price was $400,000 and included the adoption by the city of $270,000 of outstanding first mortgage bonds of the Niagara Falls Water Works Co., a former owner of the private plant. Both plants supply filtered Niagara River water.

States Propose to Regulate Arkansas River Floods

Special Correspondence

A daring river regulation proposal, on which four western states are spending effort and money, was discussed at a meeting of state water commissioners Aug. 26 and 27 at Amarillo, Tex. Regulation and utilization for beneficial purposes of the waters of the Arkansas and its tributaries was the subject of the meeting. The general plan considered would provide storage of the flood run-off in reservoirs, lakes and ponds, the stored water to serve for irrigation in the more western plains region, while in the central portion (more particularly Oklahoma) it would be utilized for domestic water supply, power development and the establishment of great fish and game preserves. Farther east in Arkansas holding back the floods will improve navigation and permit reclamation of 4,000,000 acres of overflowed lands. Regulation of the floods will have a beneficial effect on the lower Mississippi.

The Arkansas River rises near Central Colorado and flows in a general easterly direction through the state, entering Kansas in its southwest quarter. It passes across nearly the entire southern half of Kansas, entering Oklahoma about the center of its northern boundary and approximately encircling the northeast quarter of Oklahoma, flows southeasterly into Arkansas and through the center of this state. Numerous tributaries enter the main stream both from the north and south sides. The climatic and physical conditions are such that floods from the main stream and from the tributaries sometimes converge into the main stream, largely in Oklahoma, causing tremendous damage; it being estimated by the Oklahoma Irrigation and Drainage Commission that the average annual damage to the state is not less than $12,000,000, while in the year of 1923 alone it was not less than $110,000,000.

It is planned that through the adoption of an interstate treaty, such as has been proposed for the Colorado River, the states (through conservation districts) and the United States shall co-operate in the complete regulation of the stream so far as it is practicable. Further, that necessary funds shall be raised by conservation districts to be created, and that assessments be made on the basis of benefits received. Heretofore the obviously great cost of reservoir and canal construction at the head of the Canadian River, for example, has prevented the reclamation of the arid lands of that locality for the reason that the farm lands alone could not pay for the development. Now that it is proposed that Oklahoma and Arkansas generally and possibly other states shall pay in accordance with the proportions of benefits received as determined by a central authority, the proposition assumes the semblance of possibility.

At the Amarillo meeting New Mexico was represented by R. J. Freeland and J. A. Dykes, commissioners, of Tucumcari; Texas by A. S. Stinnett, commissioner, of Amarillo; Kansas by George S. Knapp, state irrigation commissioner, Topeka; and Oklahoma by E. E. Blake and W. A. Strong, members of the Irrigation, Drainage & Reclamation Commission, created at the last session of the state legislature. These men were officially appointed by the respective governors of the states named. A. Lincoln Fellows, irrigation engineer of the Division of Agricultural Engineering, U. S. Department of Agriculture, advised with the members and commissioners present. Mr. Blake, chairman of the newly founded Oklahoma commission, is devoting his entire time to the subject. Enough interest has already been displayed by the different states so that the state of New Mexico has authorized the expenditure of $20,000 in investigations; counties through which the South Canadian River flows in the Panhandle of Texas are furnishing money for preliminary surveys; and the state of Oklahoma has already made extensive investigations and it has been determined that there are plenty of reservoir sites available to conserve the flood waters, although the cost and final plans have, of course, not as yet been determined.

Utmost harmony prevailed throughout the discussion. All of the delegates promised the co-operation of their respective states so far as they themselves could assure it. A draft for a compact between the states, prepared by Mr. Blake, was presented for discussion but was not acted upon, the delegates preferring to refer the proposition to the governors, attorney generals, etc., of their states and later, probably, to the respective legislatures.

Loree Backs All-American Canal

L. F. Loree, president of the Delaware & Hudson R.R. Co., has declared that he will lead a movement for an all-American ship canal through the Oswego- Mohawk Valley - Normankill Valley route in New York, linking the Great Lakes with the sea by way of the Hudson River.

Railroad Proposed in Texas

The Quanah, Acme & Pacific Railway Co. has applied to the Interstate Commerce Commission for authority to extend its line in Texas from MacBain to Floydada, a distance of 27 miles, to provide shorter routes to Fort Worth and Oklahoma City.

McMullen Company Awarded City Subway Contract

The Board of Transportation of New York City last Friday recommended to the Board of Estimate and Apportionment the award of contract for another section of the city's new subway system to the Arthur McMullen Co. at the bid price of $3,198,100, which was the lowest of ten bids received.

The section awarded extends along Ft. Washington Avenue and Broadway from Overlook Terrace (193rd St.) to Dyckman St. This award makes thirteen sections of the Washington Heights route of the city's new subway system to be placed under contract.

The total awards to date for the construction of the Washington Heights line amount to $51,144,752. Bids for the fourteenth section of the West Side route will be received by the Board of Transportation on Oct. 6. This section extends along Eighth Ave. from 38th St. to 47th St.

Municipal Improvement Society to Meet at Des Moines

Advance notice of the program of the annual convention of the American Society for Municipal Improvements, to be held at Des Moines, Iowa, Oct. 26-30, is now available. Special attention is to be paid to paving matters, the following papers and committee reports being scheduled: R. Keith Compton, "Behavior of Bituminous Pavements under Service Conditions." Hugh W. Skidmore, "Developments in the Theory and Practice of the Design and Construction of Bituminous Pavements." H. Eltinge Breed, "Behavior of Concrete Pavements under Service Conditions." Clifford Older, "Theory of the Design of Concrete Pavements." Lion Gardiner, "Finishing Machines on the Construction of Concrete City Streets." E. E. Butterfield, Presentation of Committee Report on "Proposed Specifications for Portland Cement Concrete Pavements" including an additional section on "Recommendations on Design" embodying the latest views of Clifford Older, formerly chief engineer of the Illinois State Highway Commission and A. T. Goldbeck of the Bureau of Public Roads. A. S. Mirick, "The Salvage Value of Brick Pavements." E. E. Duff, "Use of Brick Less than 3 Inches in Depth." E. E. Butterfield, "Experimental Pavements in the Borough of Queens" describing the conditions after five to six years of service of a series of experimental pavements.

Further papers on surety bonds and day-labor construction are to be presented by George C. Warren and J. H. Ellison; on city planning by Harland Bartholomew; on stream pollution by Hans Pedersen, and power plant development by T. J. Lucas. Col. F. R. Allen, city engineer, Pine Bluff, Ark., will hold open hearings on the specifications for sewers and will try to establish, by agreement with manufacturers, a uniform method of test and safe strength values for reinforced-concrete pipe from 48-in. diameter upwards. A special program on traffic control is being prepared also.

WASHINGTON NOTES

EVERY effort is being made by the joint board of engineers to complete the investigations along the St. Lawrence during this field season. The very favorable season has brought within the range of probability what had appeared at first to be impossible. By requiring the engineers' report by April a very difficult task was prescribed. The chances now seem to favor the completion of the report on time.

The contract has been let for the horizontal holes which are to be drilled from a shaft on Barnhart Island. An enlarged working chamber has been prepared at the bottom of the 85-foot shaft. These horizontal holes, with the other borings which have been made and which will be made from a similar shaft on Long Sault Island, will establish the character of the foundations on which will rest one of the important dams of the plan likely to be adopted. The Long Sault shaft will have reached the required depth by October 1.

The section of the river from Messina to Cornwall has been depicted in a large scale relief model, which just has been completed. This model is now being shown at the Corps of Engineers in Washington, but will be sent to Detroit in the near future where there is greater use for it.

ASSURANCES have been given the Muscle Shoals Commission by Chairman Davis of the Federal Power Commission that no applications for rights on the upper Tennessee River will be granted pending the formulation of the commission's report, which must be ready Nov. 15. Secretary Davis gave this assurance when advised by the staff of the Federal Power Commission that no one of the eleven applications on the upper Tennessee would be laid before the commission, in the ordinary course, prior to Nov. 15.

The only one of the eleven applications which is in final form is that of the Hiawasse River Power Co. The death of the president of that corporation, however, has given rise to uncertainties which would have precluded the consideration of that application had there been no request from the chairman of the Muscle Shoals Commission.

THE APPRAISAL and sale of the Williston (North Dakota) irrigation project was authorized by Congress last March. This was one of the projects built by the U. S. Reclamation Service, and has been operating at a loss for many years. The area irrigated was so small that Congress decided to discontinue it in accordance with this act. Sale or lease of the project by competitive bid was authorized by the Secretary of the Interior on Sept. 24. Bids are to be received Nov. 2 at Williston. The property to be disposed of includes an electric power system, irrigation works, city waterworks, lease of a coal mine, and the purchase of certain miscellaneous equipment. Inquiries have already been received at the Department, and real competition in the bidding is expected.

THE Bureau of Reclamation will readvertise for bids for the construction of the power plant at Yuma, Ariz. The original bids were in excess of the appropriation available. Sufficient changes have been made in the specifications to bring the work within the limits of the money available, it is believed. The opening of the new bids probably will take place early in December.

Canadian Good Roads Association Holds Seventh Annual Meeting

Every province of Canada was represented at the seventh annual convention of the Canadian Good Roads Association held at Quebec Sept. 23 and 24, about 150 delegates, including many government officials being in attendance. A prominent feature was an address by A. W. Campbell, Federal Commissioner of Highways, who stated that of the $20,000,000 provided by the Dominion Government to supplement provincial expenditures, about $18,000,000 had been expended on the construction of more than 6,000 miles of a projected mileage of 8,145 miles. He pointed out that as a result of this enlightened policy the tourist traffic had greatly increased as 2,000,000 American motor cars had entered last year leaving about $140,000,000 in the country.

A paper read by S. L. Squire advocating the levying of taxation on municipalities to pay for the roads gave rise to much controversy, his views being opposed by several speakers. Resolutions were adopted approving the principle of federal aid to road-making and calling the attention of the government to certain roads under its control and urging some arrangement with the provinces whereby these roads could be put in good condition for traffic.

Officers were elected as follows: President, Hon. W. R. Clubb, Minister of Public Works, Manitoba; first vice-president, Hon. George S. Henry, Minister of Public Works, Ontario; second vice-president, Hon. John Oliver, Premier of British Columbia; secretary-treasurer, George A. McNamee, Montreal.

An agreement for the co-ordination of the activities of the Canadian Good Roads Association and the American Road Builders Association in the study of traffic problems was arrived at by the executive committees of both associations at the final business session of the convention.

Bids Asked on Arlington Piers

Bids for the construction of the piers and part of the masonry of the Arlington memorial bridge across the Potomac River at Washington, D. C., will be advertised Nov. 15. This contract will cover construction of the piers and placement of stone facing to the spring line of the arches. It is estimated that this portion of the work will cost in the neighborhood of $3,000,000. Lt.-Col. C. O. Sherrill is executive secretary of the Arlington Memorial Commission.

Random Lines

Blah-Blah Statistics

"A warehouse one mile square and thirty-eight stories high would be filled by the water-borne commerce handled at deep-water ports of the United States during the year 1924, and a train, loaded with the contents of that warehouse, traveling at a rate of thirty miles an hour would require more than three months to pass a given point. These facts, developed by analysis of a survey of the water-borne traffic of the United States in 1924, prepared by the Bureau of Research, United States Shipping Board, aid in comprehension of the magnitude of our water-borne commerce."

So says a recent bulletin of the United States Shipping Board. Of course every statistician knows that it is much easier for the ordinary dub to comprehend this mammoth warehouse and incomprehensible train than it is for him to imagine the figure 250,000,000 tons, which is what the analogy is trying to represent.

* * *

A Suspension Dam Used By the American Security & Trust Co. of

Washington, D. C. To Illustrate Industrial Development.

* * *

How Use Controls Design

"Distrust of the power of law to effect social changes is widespread. It may go too far. A dam erected to stop a river fails, but a dam built to divert a stream against turbine wheels develops power and creates wealth."—Chicago *Tribune*.

* * *

Langwidge!

"At this time of the year young Yale is getting together for the fall session and the Engineer veterans who, if not all college graduates, at least have been through the "University of Hardnox," may derive a little mild amusement (not unmixed with envy) from the up-to-date garb and mannerisms of the students who are much in evidence and range from lordly seniors lounging on the verandas of their club and fraternity houses to humble freshmen worrying over their entrance exams., and seeking a boarding place where their insignificance will be tolerated."—From the blurb of the press agent of the American Society of Mechanical Engineers announcing the Annual Machine Tool Exhibition at New Haven.

Engineering Council Board to Meet at Columbus

The next meeting of the Administrative Board of the American Engineering Council will be held at Columbus, Ohio, Oct. 29 and 30 under the auspices of the Engineers' Club of Columbus. It is reported that chief among the topics to come before the board is the study of commercial aviation now being made by the council jointly with the Department of Commerce.

Steel Construction Men to Meet at White Sulphur

Announcement has just been made that the annual convention of the American Institute of Steel Construction will be held at White Sulphur Springs, Nov. 11-14. The program of the meeting has not yet been announced. Offices of the Institute are at 350 Madison Ave., New York City.

Highway Research Board to Meet in December

Announcement has been made that the fifth annual meeting of the Highway Research Board of the National Research Council will be held in the National Academy of Science and Building, 21st and B Sts., N.W., Washington, D. C., Dec. 3-4, 1925.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Fall Meeting, Montreal, Que., Canada, Oct. 14-16, 1925.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York City; Annual Convention, St. Louis, Mo., Oct. 19-22, 1925.

AMERICAN RAILWAY BRIDGE & BUILDING ASSOCIATION, Chicago, Ill.; Annual Convention, Buffalo, N. Y., Oct. 20-22, 1925.

ASPHALT ASSOCIATION, New York City; Annual Paving Conference, Detroit, Mich., Oct. 21-23, 1925.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, Lakeland, Fla.; Annual Meeting, Des Moines, Iowa, Oct. 26-30, 1925.

CITY MANAGERS ASSOCIATION, Lawrence, Kansas; Annual Convention, Grand Rapids, Mich., Nov. 17-19, 1925.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, Washington, D. C.; Annual Convention, Detroit, Mich., Nov. 18-20, 1925.

HIGHWAY RESEARCH BOARD, Washington, D. C., Annual Meeting of the Highway Research Board, Washington, D. C., Dec. 3-4, 1925.

The Engineers Club of Kansas City, Mo., as guest of Smith Bros., general contractors for the new water supply tunnels, made an inspection tour to the sites of the tunnel shafts and to the new purification works in North Kansas City; luncheon was served at the plant at the latter place.

The Swedish Engineers Society of Chicago and the Detroit Engineering Society held a joint meeting Sept. 25 at the Detroit society's clubhouse, and was addressed by C. E. Johannson, engineer on gages with the Ford Motor Co., on "Precision Gages."

San Francisco Section of the American Society of Civil Engineers on Sept. 19 made a field trip to the subway now under construction under the Oakland estuary. A preliminary half-hour was spent with plans in the county engineer's office after which the party went down in the approach cut and inspected the work which is being done in the closed section preliminary to bringing in the sections that are to be floated to place.

Personal Notes

J. F. WARD, formerly vice-president of Rounds-Clist Co., Seattle, Wash., announces the formation of a new building and general construction company under the name of J. F. WARD, INC., with offices in the Lyon Building in Seattle. Mr. Ward graduated in engineering from Northwestern University in 1914 and served for a time in improvement work for the North Shore District in Chicago, and three years on the Pennsylvania freight terminal in Chicago. In Seattle, besides a year with the port commission engineering department, he had worked on design and construction of launching ways in a shipyard and on the Smith's Cove pier.

JOHN M. BELKNAP, who was resident engineer for The Terry & Tench Co. and The Tench Construction Co. on the construction of the Bear Mountain-Hudson River Bridge and highways, has been appointed chief engineer of The Florida Realty Associates with headquarters at Daytona. Mr. Belknap is now engaged in the laying out of Rivercrest, a large development on the banks of the St. John's River at Palatka, Florida.

R. S. DUBOIS, until recently bridge engineer with the Colorado State Highway Department, has become chief bridge designer of the Jersey approach to the vehicular tunnel under the Hudson River for the New Jersey State Highway Commission.

H. B. POTTER, a graduate engineer and since 1923 assistant to the president of the United Railways, Baltimore, Md., has been appointed general manager of the railways company; he succeeds LOUIS H. PALMER, who resigned as general manager and vice-president to assume similar duties with the Fifth Avenue Coach Company, New York City. Mr. Potter got his first street railway experience in 1904 in the construction of a small electric railway in Maine and later became its manager. In 1910 he went with the Boston Elevated Railway where he rose to be assistant general manager.

A. E. SNYDER, of the engineering department staff at Salt Lake City, Utah, has been appointed assistant city engineer in that city. Mr. Snyder has had charge of the engineering work on the Mountain Dell dam, the Northwest drainage canal and the exploration for a dam site in Big Cottonwood canyon.

DWIGHT POWELL, formerly county engineer of Canadian County, Oklahoma, has been appointed county engineer of Tillman County, in that state, taking the post made vacant some months ago by the resignation of E. L. Guyer; the position in the meantime had been filled by Willis Hughes, an assistant.

MARTIN J. CLEMENT, general manager of the central region of the Pennsylvania R.R. System, has been appointed assistant vice-president in charge of operations of the entire system, a newly created position, with headquarters at Philadelphia, Pa. Mr. Clement entered the employ of the Pennsylvania System as rodman, in 1901.

E. N. BRYAN, formerly office engineer, state division of water rights, Sacramento, Calif., has been appointed chief deputy of the division by W. F. McClure, director of the California Department of Public Works.

MAJOR WILLIAM W. BURDEN is now a member of the Robert June Engineering Management Organization of Detroit. Major Burden took his engineering degree at the University of Missouri, graduating in 1912. After serving as engineer in charge of design and construction of various projects for the city of St. Louis, he became a member of the 12th Engineers in service overseas. Major Burden has been general superintendent of construction for the city of St. Louis, also general superintendent of construction of Tiawah Tunnel and consulting engineer on the Spavinaw Dam for the water supply of the city of Tulsa, Okla.

Obituary

DR. EUGENE R. KELLEY, state commissioner of health of Massachusetts and chairman of the state's public health council, committed suicide Sept. 27 at his home in the Dorchester section of Boston, Mass. Dr. Kelley was a graduate of Bowdoin College and of Johns Hopkins University, in medical work, and had a notable record in the West for his work in public health service.

WILLIAM H. CANNIFF, president of the Nickel Plate R.R. from 1898 to 1916, died Sept. 17 at his home in Cleveland, Ohio, aged 77 years.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Bronze Welding Procedure for Cast-Iron Pipe

Code of Field Rules Derived from Collected Data on Pipe in Service

BRONZE welding of cast-iron pipe is a new development that is solving many problems especially in the gas industry where joint leakage has always been troublesome because of the high pressures that are often used in the mains. Oxwelding, using cast-iron welding rod, as a solution of leakage problems, was subject to the limitations of welding this material under field conditions where facilities for properly doing the work were not always available; for, in welding with cast-iron rod, perfect results are obtained only when there is complete fusion of the pipe as well as the rod. This, of course, requires heating the pipe locally to its melting point. By using bronze rod, however, the temperature of the pipe need never exceed approximatly 1200 deg. F. Bronze welded joints, because of their equally strong structure and lower forming-temperature, have advantages over cast-iron welded joints especially under field conditions.

Operating Data and Rules — The action of the bronze weld is somewhat as follows: Applying the bronze at as low a temperature as possible to the preheated pipe joint, a tinned surface will be formed. This is somewhat similar to the preliminary operation in soldering, but in this case the tinning action seems to proceed automatically, slightly ahead of the exact point of application of the bronze and represents the basic and most important action for good results. The weld is built up on this surface.

Data on 22 bronze welded pipe lines laid in 1924 and located in widely separated parts of the United States and Canada have been assembled. On 12 of these there were no defects of any kind found; minor defects were noted in 8 of the lines and serious ones on 2 lines. The failures on the latter two lines were attributed to acknowledged porosity and laminations at the end of the pipe which contributed to a defective weld.

The following results and deductions have been obtained by the Linde Air Products Co. from its tests and experience with the bronze welding method.

a. The pipe shall have plain ends finished square. The ends shall be free from porosity, blow holes, sand inclusions, laminations and cracks.

b. It is essential that a good quality flux be used to obtain proper tinning. Oxygen and acetylene are the only suitable gases.

c. The ends of the pipe shall be separated about $\frac{1}{8}$ in. and the weld shall be as narrow as possible.

d. The welding rod shall conform to the following specifications:

	Per Cent
Copper	59-62
Tin	0.51
Lead	not over 0.10
Iron	not over 0.20
Aluminum	none
Zinc	remainder

e. The welding rod shall be of the following sizes:

Normal Pipe Size-In.	Diameter Rod-In.	Length In.
2-10 inclusive	3/16	36
12	1/4	36

f. The joint shall be tack-welded at three equally-spaced points. The maximum length of tack is about 1 in. All tacks shall be melted out in the course of welding the joint.

g. The floor of the trench shall be as level as possible and free from obstructions which will impose undue strain on the pipe. If necessary, blocking and tamping should be employed. Although a rather long section of pipe will successfully act as a beam under its own dead-load, the backfill material and tamping operations often impose breaking stresses on the joints.

h. Sections of pipe line containing 6 lengths may be successfully lowered into the trench as a unit. For the lowering operations, windlasses mounted on tripods may be used spaced approximately 25 ft. The sections should be lowered gradually, evenly and progressively.

i. Provision for expansion and contraction is, of course, necessary to compensate to some degree for temperature changes. However, local conditions are of such ruling importance that no definitely universal rule can be made.

j. For rolling welds, about one-quarter of the periphery of the pipe should be welded, after which it should be rotated approximately 90 deg.; that is, always weld on top of the pipe.

k. For position welds, the welding operations should begin on the bottom and proceed 180 deg. both ways.

Business Notes

B. F. STURTEVANT CO., Boston, Mass., has been awarded the contract for the fans, motors, transmission and control systems for the Holland Vehicular Tunnel under the Hudson River at New York City. The contract price was $571,691. The motors and transmission apparatus will be purchased from outside firms by the Sturtevant Company.

L. M. ZIMMER has been promoted from assistant general sales manager to general sales manager of Linde Air Products Co., New York City, manufacturers of oxygen, and of the welding gas division of the Prest-O-Lite Co., Inc., manufacturers of dissolved acetylene. Mr. Zimmer succeeds L. M. Moyer, who has recently resigned.

CONVEYORS CORPORATION OF AMERICA, Chicago, Ill., announces the appointment of Rowland & Burns, 39 Cortlandt St., New York City, as district engineers for New York and vicinity to handle its products.

AMERICAN PUMP & SUPPLY CO., Detroit, announces the annexation of the F. A. Green Engineering Co. The resulting organization is now equipped to furnish engineering information and instruments on American Well Works pumps, Pacific Flush Tank sewerage apparatus, Huber stokers, Whitlock heaters, Dean electrical control, and Bayer soot blowers.

BORCHERT-INGERSOLL, INC., 2360 University Ave., St. Paul, Minn., announces the acquisition of the Monarch Tractors, Inc., line of crawler tractors for the state of Minnesota.

CHADWICK BROS. CO., 432 Broadway, Milwaukee, Wis., is erecting a new office and warehouse building which is to be ready for occupancy on Oct. 1. The company is distributor for the Baker Mfg. Co., Barber-Greene Co., Byers Machine Co., Cleveland Tractor Co., Leach Co., Lee Trailer & Body Co., and Owen Bucket Co.

WOOD HYDRAULIC HOIST & BODY CO., Indianapolis, Ind., announces a change in its address to 252 North Capitol Ave.

COMMERCIAL BODY CORP., Buffalo, N. Y., is announced as an authorized distributor for the Heil Co., Milwaukee, Wis., to mount and service all the Heil body and tank equipment.

MORRIS ENGINEERING CO., 30 Church St., has been formed by L. H. Morris, formerly vice-president, General Equipment Co., New York City, and E. E. Fort, for several years Philadelphia representative of the same company. The new company will act as Eastern sales agent for the Ohio Locomotive Crane Co., Bucyrus, Ohio, and, in addition, is prepared to finance the purchase or sale and supervise the maintenance and operation of steam shovels, draglines, locomotives, dump cars, etc.

G. K. VIALL, Chain Belt Co., Milwaukee, has been placed in charge of the service on Rex mixers and pavers.

A. LIETZ CO. has just opened a new store in Los Angeles, Calif., at 1001 S. Hill St., where it will carry a complete stock of its instruments together with drafting materials and field equipment for the engineer and draftsman.

FRICK & LINDSAY CO., Pittsburgh, Pa., announces the resignation of E. H. Vockrodt as purchasing agent. Mr. Vockrodt has accepted a position with the Standard Engineering & Man-

ufacturing Co., Pittsburgh, as treasurer, and will be in charge of the sales of their heating equipment. E. L. Goucher has been appointed purchasing agent for Frick & Lindsay.

WILLIAM BLANCHARD CO., Boston, Mass., manufacturer of shades for pivoted steel sash windows, is moving into a new plant. This will be the fifth building occupied by the company as it has outgrown its quarters four times.

Equipment and Materials

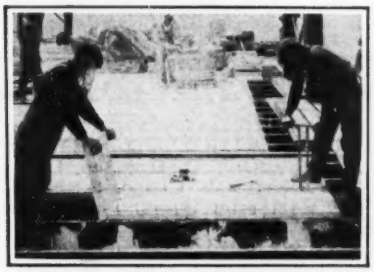
Precast Gypsum Slabs for Floor and Ceiling Construction

In making recent additions to a department store in Rochester, N. Y., a comparatively new and light-weight fireproof floor, known as Gypsteel precast floor, manufactured by Structural Gypsum Corp., New York City, permitted the construction of five additional stories, whereas the original design had provided for only three similar to the lower six stories. The Gypsteel floor system consists of reinforced precast gypsum units in combination with a structural steel frame made up of standard steel channels spaced 2 ft. 6 in. on centers. Beneath the channels are hung 2-in. gypsum slabs forming a flat ceiling; floor slabs of the same composition and 2½ in. thick are placed on top of the channels.

INSTALLING CEILING SLABS

The ceiling slabs are 30 x 24 in. and are reinforced with two flat steel bars located 1 in. from the bottom and projecting about 1 in. from each end. Hangers made of ¼ x 1-in. flats are fastened to the projecting reinforcement and support the ceiling slabs. The ends of abutting slabs are rabbetted. Beveled ribs are molded along the sides of the slabs at the bottom edges. There is thus formed a ½-in. slot between adjacent slabs extending downward from the top surfaces of the slab. These end and side joints are filled with gypsum grout.

The floor slabs, also 30 x 24 in., reinforced with ⅜-in. rods, are designed for a maximum live load of 150 lb. per sq.ft. They are laid after the ceiling slabs have been hung and grouted. The reinforcing rods project from the ends of the slab and are tied together as shown in the accompanying illustration. They lie in the rabbets formed in the ends of the slab which are finally flushed full of gypsum grout.

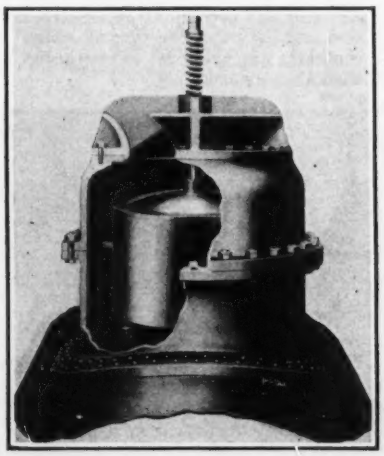


INSTALLING FLOOR SLABS

On this job, each shipment of slabs was erected the day it was received, eliminating the cost of double handling and the necessity of storage space. A single brown coat of gypsum plaster properly sanded and the usual finish are applied directly to the ceiling in this type of construction. The chief advantages of the Gypsteel system lie in its light weight and fireproofing qualities.

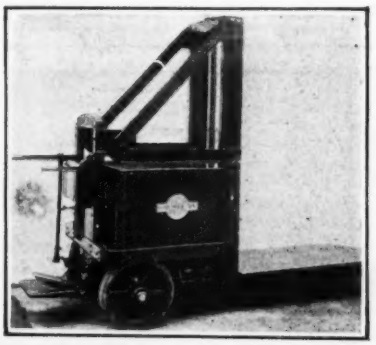
Penstock Air Valve

The new air valve manufactured by Coffin Valve Co., Boston, Mass., to prevent penstock collapses consists essentially of a bronze float, which rides loosely in bronze faced guides. The bottom of the float is perforated to prevent collapse under high pressure and also to reduce the shock on closure, by permitting water to rise in the float and compress the entrapped air. When closed, the machined seat on the bronze float bears against a special composition seat ring in the housing. Upon filling the penstock, the air will escape through the valve until the water raises the float to its seat. Thus with water pressure in the penstock, the valves are tight. If the water is drawn off from the penstock, the float drops, the valve opens and air is admitted. The opening of the valve is cushioned by the spring above the yoke as shown in the illustration. Where these valves are to be used in freezing temperatures, they should be carefully housed and freezing prevented by electric space heaters. It should be noted that valves of this type do not take care of small accumulations of the air in pipe lines and where this is necessary a float and lever type of air valve is usually used.



New Electric Lift Truck

An electric truck suitable for stacking material of different kinds in construction storehouses and for moving material on platforms, from freight cars, in warehouses, etc., is a new product of the Crescent Truck Co., Lebanon, Penn. This truck has a lifting capacity of 4,000 lb. to a height of 6 ft. The elevating unit is operated through a worm and worm wheel to a single screw, the complete unit operating on ball bearings and running in oil.



The overall dimensions of the truck are 112 in. long, 41 in. wide and 87 in. high. The wheel base is 59 in., and the truck has a turning radius of 95 in. The lifting platform is 54 x 26 in.

Publications from the Construction Industry

Drag Clam Bucket—DUNBAR & SULLIVAN DREDGING CO., Buffalo, N. Y., is publishing a 10 page booklet describing the development, operation and construction features of the Dunbar drag clam bucket.

Electro-Chlorination — MARSH ELECTRO-CHLORINATION CO., INC., New York City, describes its electric chlorination system for use in sterilizing and purifying the water in swimming pools in a new bulletin that they have just issued. A list of representative institutions using this system is also given.

Building Construction — THE FOUNDATION CO., New York City, has issued a pamphlet describing the shops of the Southern Railway Co. at Atlanta, Ga., which it designed and built.

Engineering News-Record Statistics of the Construction Industry

October 1, 1925 — *in the United States* — Vol. 95, No. 14

Engineering News-Record CONSTRUCTION COST Index Number (1913 = 100)

MONTHLY

January, 1924 to Date

October, 1925	205.35
September, 1925	202.10
October, 1924	207.55
Peak, June, 1920	273.80
1913	100.00

1924

Jan.	217.90	May	222.38	Sept.	211.25
Feb.	220.30	June	216.85	Oct.	207.55
March	224.60	July	214.40	Nov.	205.70
April	221.60	August	213.15	Dec.	208.58

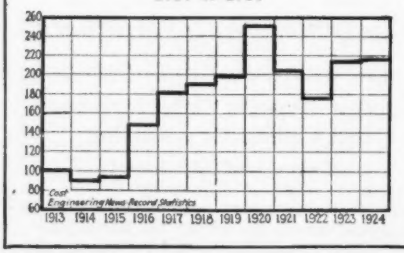
1925

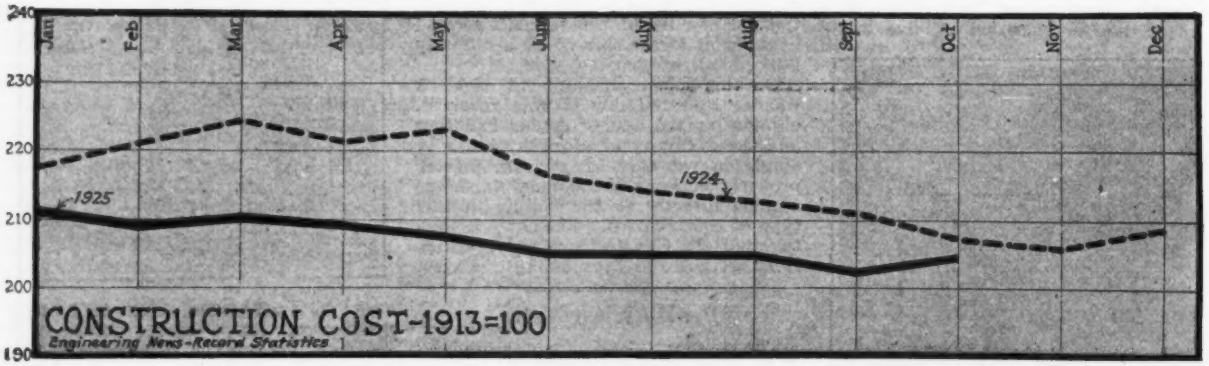
Jan.	210.40	May	207.20
Feb.	209.70	June	204.60
March	210.20	July	204.60
April	209.55	August	204.60

ENGINEERING NEWS-RECORD'S Construction Cost Index Number is 3.25 points above the September level, owing to higher cost of structural material and labor. The average rate for common laborers is now 54c. per hr. for the entire country as against 53c. last month and 56c. one year ago. Thus general construction cost is one per cent lower than a year ago and 25 per cent under the peak; it is 105 per cent above the 1913 level.

YEARLY

1913 to 1924





Engineering News-Record CONSTRUCTION VOLUME Index Number (1913 = 100)

MONTHLY

January, 1924 to September, 1925

September, 1925	262
August, 1925	266
September, 1924	159
Peak, August, 1925	266
1913	100

1924

January	125	May	194	September	159
February	144	June	149	October	164
March	161	July	161	November	128
April	159	August	162	December	145

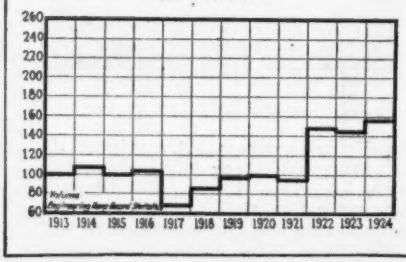
1925

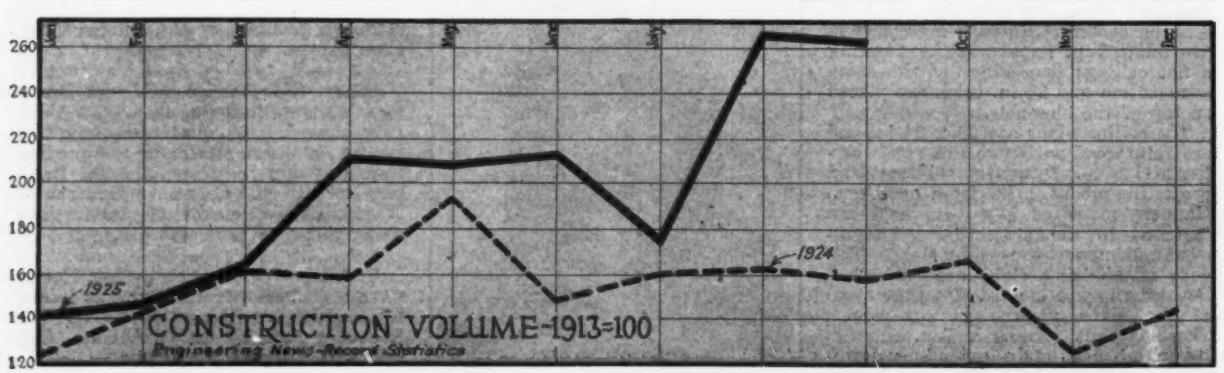
January	141	April	211
February	145	May	209
March	161	June	214
		July	178

ENGINEERING NEWS-RECORD'S Construction Volume Index Number is 262 for the month of September, and 154 for the whole of 1924, as against 100 for 1913. This means that the actual volume of construction in 1924 (not the mere money-value of the contracts let that year) is 54 per cent above the volume of construction for 1913. The monthly volume number, 262 for September, 1925, contains the increment of construction and indicates the rate at which contracts are being let as compared with 1913 awards.

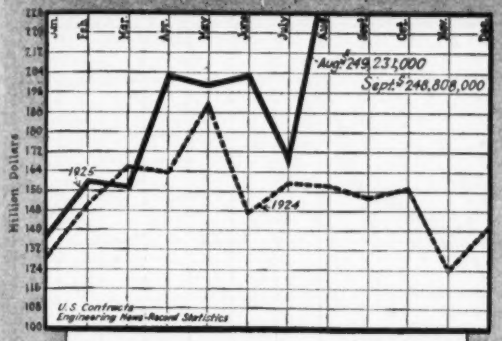
YEARLY

1913 to 1924



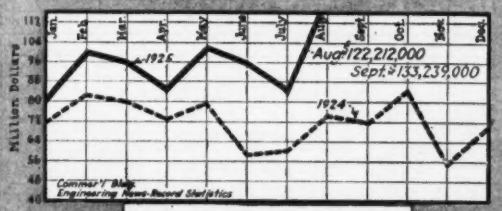


Monthly Statistics of the Construction Industry

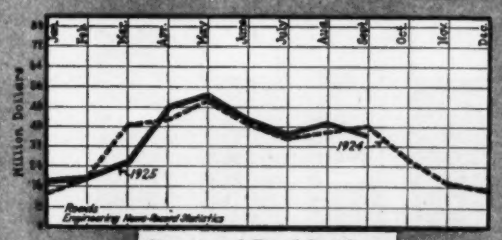


Contracts Awarded in the United States
Reported in E. N. R.

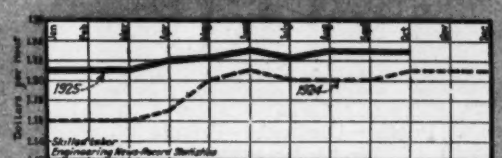
Industrial Building Awards
$40,000 and Over



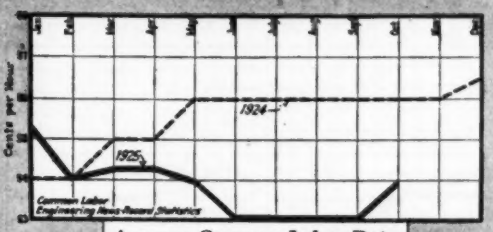
Commercial Building Awards
$150,000 and Over



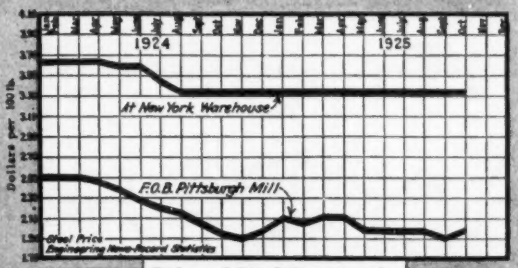
Street and Road Lettings
$25,000 and Over



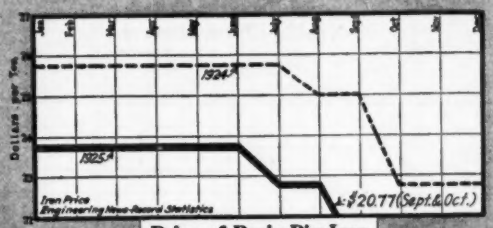
Average Wage of Skilled Building Trades
Bricklayers, Carpenters and Steel Erectors



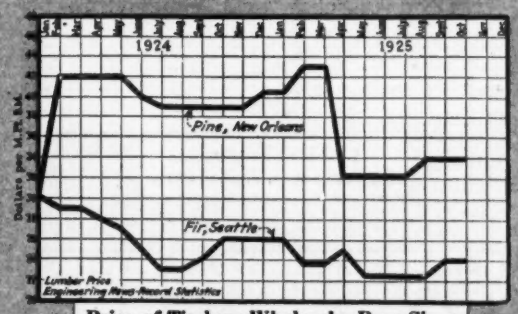
Average Common Labor Rate
Pick and Shovel Men



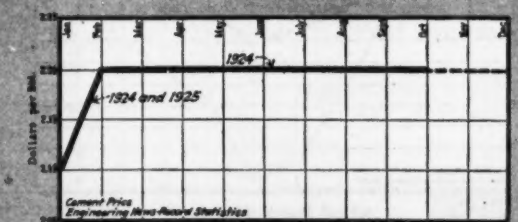
Price of Steel Structurals
Shapes 3-In.; Plates ¼-In.



Price of Basic Pig Iron
F.o.b. Pittsburgh

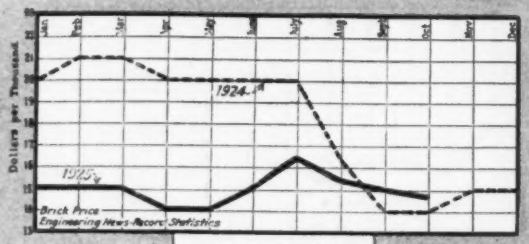


Price of Timbers, Wholesale, Base Sizes
Car Lots to Contractors

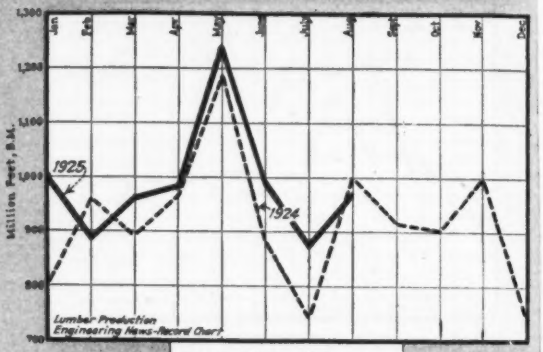


Net Price of Portland Cement
Car Lots, F.o.b. Chicago

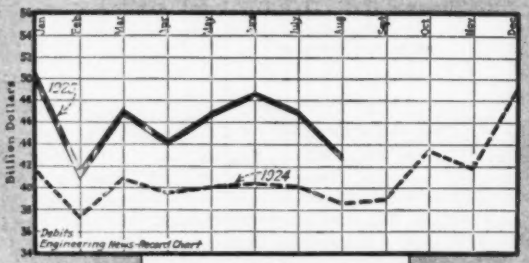
Monthly Statistics of the Construction Industry



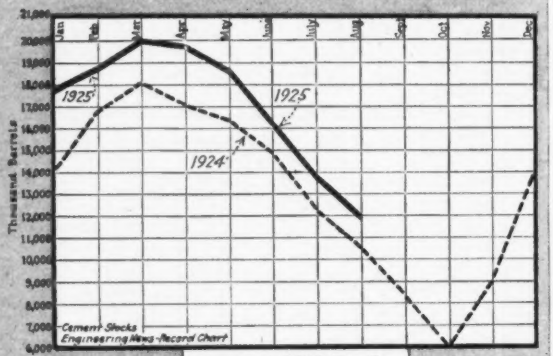
Price of Brick
At Dock, New York



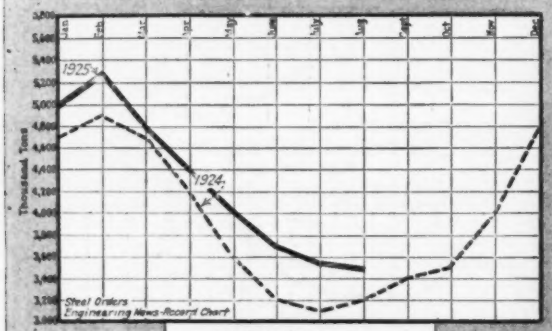
Lumber Output
Nat. Lumber Mfrs. Assn.



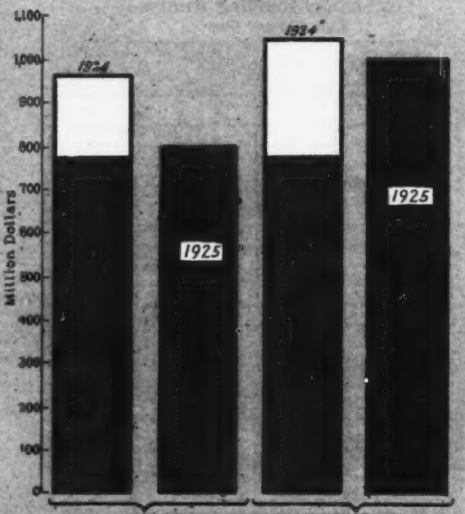
General Business Trend
Bank Debits—Federal Reserve



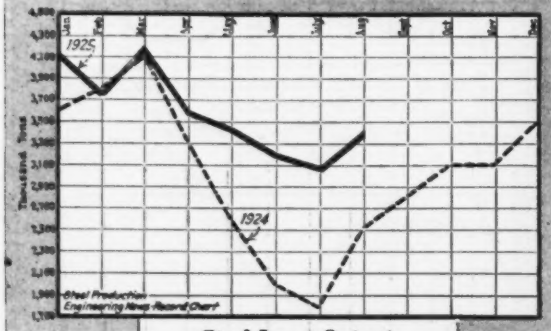
Cement Mill Stocks
Geological Survey



Unfilled Tonnage
On Books of U. S. Steel Corp.



Public—Contracts—Private
Jan. 1 to date
Reported by E. N.-R.



Steel Ingot Output
Gross Tons; Am. Iron and Steel Inst.

September Contracts Reach Record Total for That Month—This Year to Date 20 Per Cent Ahead of Last

ANOTHER record has just been hung up in the annals of construction contract letting and actual physical volume of work accomplished.

September, 1925 was the heaviest for that month on record, so far as money value of contracts is concerned, and in volume, was not exceeded by any other month except August of the current year.

In fact, the only months during the past twelve years, to show a volume more than twice that of the 1913 average, were: October, 1919, May, 1922, August, 1925 and September, 1925.

The minimum in each class, observed in arriving at the totals in the accompanying table, is as follows: Waterworks and excavations, $15,000; other public works, $25,000; industrial buildings, $40,000, commercial buildings, $150,000.

Following is a tabulation of the September totals, at the above minimum in each class and covering the entire country, for the past thirteen years:

1913	$40,776,000	1920	$117,729,000*
1914	38,774,000	1921	115,535,000*
1915	64,713,000*	1922	130,815,000
1916	90,764,000	1923	166,940,000
1917	90,213,000	1924	153,019,000
1918	130,751,000	1925	248,808,000
1919	106,957,000		

*Five issues of E. N.-R.

Contract letting is on the up-trend in public, industrial and commercial building construction and excavating work. The six states showing the most notable gains during September were: Florida, Kentucky, Georgia, Nebraska, Maryland and Massachusetts. Contract letting is extremely slow in Arizona, Wyoming and Utah.

The sixteen biggest contracts of the month were: A hotel, New York, N. Y., $17,000,000; channels, jetties, harbor, etc., Hollywood, Fla., $15,000,000; office building, New York, N. Y., $10,000,000; store and theater, Atlanta, Ga., $6,000,000; club, Washington, D. C., $6,000,000; art museum, Philadelphia, Pa., $4,584,000; hotel, Boston, Mass, $4,000,000; hotel, Boca Raton, Fla., $4,000,000; gas plant, New York, N. Y., $4,000,000; power plant, Fine Grove, Pa., $3,600,000; office building, Philadelphia, Pa., $3,300,000; hospital, Creedmoor, N. Y., $3,287,000; apartment, Chicago, Ill., $3,000,000; apartment, New York, N. Y., $3,000,000; power plant, New Braunfels, Tex., $3,000,000; office and store, Chicago, Ill., $3,000,000.

Business Briefs

Call money ranged from 4½ to 5½ per cent, Sept. 28: year ago, 3 per cent.

Time loans: short terms, 4½ per cent; longer periods, 4¾ per cent.

Commercial paper: best names, 4½ per cent; other names, 4½ per cent.

FOREIGN EXCHANGE (Demand)

	Par	This Week	Last Week	Year Ago
Sterling	$4.86⅔	$4.83⅛	$4.84⅛	$4.43⅞
Franc	.193	.0472½	.0473½	.0524
Lira	.193	.0408½	.0411¼	.0437½
Mark	.238	.2381	.2381	
Florin	.402	.4019	.4018	.3854
Peseta	.193	.1438	.1442	.1330
Krona	.268	.2683	.2681	.2661

Value of Contracts Let in the United States and Canada, September, 1925

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Far West	United States	U. S. Jan. 1 to Oct. 1	Canada
Waterworks	$19,000	$434,000	$45,000	$1,489,000	$1,155,000		$3,142,000	$46,754,000	$471,000
Sewers	46,000	3,765,000	72,000	2,659,000	1,211,000	345,000	8,098,000	62,888,000	353,000
Bridges	391,000	479,000	1,451,000	532,000	470,000	1,351,000	4,674,000	50,451,000	25,000
Excavation, dredging, etc.			15,103,000	78,000	497,000	188,000	15,866,000	24,606,000	292,000
Streets and roads	1,455,000	10,236,000	7,179,000	5,439,000	10,593,000	2,045,000	36,949,000	347,511,000	774,000
Industrial building	2,569,000	5,445,000	12,935,000	2,473,000	9,360,000	1,210,000	33,992,000	165,610,000	100,000
Commercial building	17,069,000	66,203,000	13,503,000	21,262,000	12,684,000	3,017,000	133,738,000	963,098,000	975,000
Federal government	35,000	602,000	127,000	38,000	524,000	41,000	1,367,000	26,107,000	
Unclassified	802,000	7,174,000	6,200,000	473,000	2,254,000	73,000	10,982,000	167,605,000	431,000
Sept., 1925	$22,386,000	$94,338,000	$50,621,000	$34,443,000	$38,750,000	$8,270,000	$248,808,000	$1,854,630,000	$3,321,000
Sept., 1924	20,375,000	31,110,000	13,871,000	35,000,000	31,951,000	17,700,000	153,019,000		8,113,000
Aug., 1925	16,367,000	104,281,000	23,252,000	47,349,000	45,699,000	12,283,000	249,231,000		11,421,000
1925, Jan. 1 to Oct. 1	**153,212,000**	**664,149,000**	**183,326,000**	**324,346,000**	**330,052,000**	**199,545,000**	**1,854,630,000**		**62,566,000**
1924, Jan 1 to Oct. 1	112,180,000	451,952,000	175,097,000	336,657,000	257,858,000	203,959,000	1,537,713,000		73,183,000

Labor Rates and Conditions Throughout the Country

FAVORABLE trade factors continue to heavily outweigh the depressing influences, comparing the current business situation with that of Sept. 1.

Construction stands out conspicuously among the most active industries. Other important developments are: record freight loadings; improvement in iron and steel demand, the agricultural situation and cotton textile manufacturing; higher stock exchange quotations, grain prices and rate of railway earnings; increased per capita earnings; gain in exports over imports; fewer business failures; gain in production of pig iron, steel ingots, buses and closed cars, woolen textiles and shoes; increased employment in the manufacture of agricultural implements, confectionery, leather, boots, shoes, fertilizer, stoves and pottery; briskness in wholesale and retail trade; favorable money rates; foundation of new corporations; increased demand for bituminous coal; signs of breaking away from the recent practice of hand-to-mouth buying.

Principal among the weak spots are: the anthracite coal strike; decreased employment in the manufacture of paper, machine tools, tobacco, musical instruments, rubber boots and shoes and food accessories; reduced pay-rolls in industries producing vehicles and woolen textiles; smaller returns to the producer for live stock, cotton and wool; decline in bank debits; uncertainty in yield of corn and cotton crops.

Local conditions in several of the most important industrial centers follow:

Atlanta — Slight excess of building trades mechanics and common laborers reported. Very little unemployment otherwise.

Baltimore — Building active; small amount of unemployment present in other lines.

Birmingham — Construction conditions excellent; small surplus of building laborers.

Boston—All building trades are back at work and labor disturbance, started five months ago, has completely disappeared from the field.

Cincinnati — Surplus of building trades mechanics; construction slow.

Chicago — Jurisdictional dispute between bricklayers and plasterers affecting only two big jobs in Chicago. Tile setters, marble setters and fireproofers, on one project, have now entered the controversy. The situation with regard to bricklayers, plasterers and structural iron workers is clearing up. Practice of paying bonuses less marked than formerly.

Cleveland—Unskilled labor supply in excess of demand. Trouble between two building trades councils settled by mandatory injunction.

Dallas—Surplus of common laborers; slight excess of skilled building trades craftsmen.

Denver — Construction especially active. Extensive municipal improvement program under way. Labor exceedingly plentiful.

Detroit—Plenty of building laborers; slight scarcity of highly skilled metal workers.

Kansas City, Mo. — Building sufficiently active to absorb all local mechanics. Common laborers plentiful despite active municipal improvement program.

Los Angeles — Surplus of laborers smaller than a month ago. Construction absorbing a large percentage of the men.

Minneapolis—Enough work available to engage all local building trades mechanics; municipal improvements also taking common laborers.

New Orleans — Plasterers demand advance of 25c. per hr. over present scale of $1.50, effective Dec. 21, 1925. Double time for all overtime is also requested.

Philadelphia — Construction on in-

Current Building Trades Wage Rates Per Hour

(Higher rates indicated by +, decreases by —)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$1 12½	$0 70	$0 70	$0 50	.....	$0 75	$0.25@.30
Baltimore	1.50@1.75	1.00@1 20	1.00@1.12½	1 00	$0.65	1 12½	.40
Birmingham	1.00@1.50	.35@.87½	.75@1 25	.50@.75	.....	.75@1 75	.20@.40
Boston	1 25	1.10	1.10@1.30	.70@.75	1.10	1 10	.50@.75
Cincinnati	1 50	1.25	1.25	.92½	1.25	1.25	40@55
Chicago	1 50	1.37½	1 37½	.87½	1.37½	1.37½	.82½@.87½
Cleveland	1 50	1 25	1.30	.87½	1.00	1 50	.87½
Dallas	1 62½	1 12½	1 12½	.40@.75	.87½	1 12½	.30@.50
Denver	1 62½	1 12½	1.12½@1.18¾	.81¼@.87½	1.00	1.15¾	.35@.55
Detroit	1 50	.70@1.00	.85@1 00	.90	.85@1 00	1.12½	.50@.60
Kansas City	1.37½	1.25	+1 12½@1.25	.90	1.12½	1.12½	—.30@.75
Los Angeles	1 25	+1.00	+1.00	.75	+.75@1.00	.87½	.50
Minneapolis	1.12½	.87½	.87½	.71½	.....	.87½	.50@.55
Montreal	+1 00	+ 65	.62½	.30@.35	.50	+ .80	.20@.35
New Orleans	1.25	.90	1.00	.65	.85	1.25	.35@.40
New York	1.50	1.31¼	1.50	1.00	1.00@1.12½	1.50	.55@.75
Philadelphia	1.50	1.12½	1 02½	1 12½	1.00	1.12½@1.25	.45@.50
Pittsburgh	1.62½	1.37½	1.37½@1.43¾	+1 09¾	.....	1.43¾	+ 75
St. Louis	1.75	1.50	1.50@1.65	1.15@1.25	1.50	1.50	.45@.87½
San Francisco	1.25	1 00	1 00	.81¼	1.00	1.12½	.50@.55
Seattle	1 37½	1 12½	1 00@1 12½	1 00	1.00@1.12½	1 12½	.50@.62½

crease, particularly in industrial work. Plenty of mechanics available. Common labor supply augmented by influx of men from coal strike area. There is a tendency on the part of building labor to move for higher wage rates.

New York—Jurisdictional dispute between bricklayers and plasterers still in force. Despite an extensive municipal improvement program, there are more laborers than the market requires.

Pittsburgh—There is steady improvement in employment at the steel mills and in allied industries. Building laborers actively engaged.

St. Louis—Common laborers refused increase of 12½c. per hr. A subsequent request for a rise of 5c. per hr. also ignored. Caisson workers, however, were granted $1 per hr., against the old rate of 87½c., retroactive to July 1, 1925. Plumbers strike abandoned when journeymen failed to obtain the sanction of the international organization. Demand was for advance of $2 per day above the present rate of $12, which rate remains in force until Feb. 3, 1926.

San Francisco — Shortage of bricklayers and plasterers reported. Construction continues active with plenty of work in sight.

Seattle — Extensive municipal improvements and a liberal construction program will furnish employment for a large number of men. The supply, however, is adequate to meet demand.

Monthly Prices of Construction Materials

Ups and Downs of the Market

PRICE fluctuations are not very strongly marked in the current market for construction materials. Advances are evidently slightly in excess of declines. This condition is notable in view of the fact that the volume of construction is unusually heavy for this time of the year.

Pig Iron—Buying active but in small tonnage lots; prices firmer. Minimum quotations on No. 2 f'dry., Southern, about $1 per ton above a year ago.

Railway Supplies—Aside from a drop of 10c. per 100 lb. in the minimum on standard spikes, railway supplies showed no price changes during the month. Light rails are about $5 per ton under October, 1924 quotations; standard rails have not changed in over a year. Mills are not over-active on specifications for cars and locomotives at the present time.

Pipe—Steel pipe mills are running close to capacity; prices show the usual stability. There is a general upward trend in cast-iron pipe throughout the country. Clay drain tile is firm and unchanged. Aside from a slight fluctuation in sewer pipe mostly along the Atlantic seaboard, there were no important changes during the month.

Road and Paving Materials — Road oils, paving stone, flagging, curbing and wood blocks show little change, compared with prices in effect one month ago.

Sand, Gravel and Crushed Stone—Of twenty cities reporting regularly to *Engineering News-Record* on prices of aggregates, but one, Chicago, showed any changes. In this instance the slight rise was due to freight rate adjustments.

Lime and Cement — There is some fluctuation in lump lime prices, while hydrated, if anything, is tending upward. Portland cement prices are stable. Kansas City reports a drop of 20c. per bbl. on Ft. Scott natural cement.

Brick and Hollow Tile — Common brick prices registered very few changes during the past month. In the Eastern states, however, the anthracite coal strike, if long continued, may sufficiently affect the price of bituminous to cause a rise in brick. The hollow tile market in Boston and New York is affected by a slight downward tendency. Last month declines were reported in the West, particularly in the St. Louis district. That this situation is probably temporary is suggested by the current advance in this material at Detroit.

Structural Steel—Finished steel market is steady, with little tendency to climb. Prompt deliveries required on most orders placed. Steel bars remain firm at $1.90@$2; shapes same as bars and plates, $1.80@$1.90 per 100 lb., Pittsburgh. Chances of a rise are more in favor of plates than shapes from present indications.

Lumber — Production, shipment and new business are increasing from week to week. Price advances are far in excess of declines in most of the important centers. Long-leaf, yellow pine demand is most active in boards, finish, lath, upper grades of flooring, special cutting and railway material except car decking.

Iron and Steel Scrap—Market is dull but stands in anticipation of greater activity at foundries in the near future.

Miscellaneous—Tendency is upward in black steel sheets and manila rope. Boiler rivets and linseed oil are down. Wire nails, though still tending downward at warehouses in the West, are reported firmer at mills.

E. N.-R. Prices of Construction Materials

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton f.o.b.:

	Oct. 1	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25@2.75)	$23.05	$22.05@22.55
Northern Basic	22.27	20.00
Southern Ohio No. 2 (silicon 1.75@2.25)	22.77	21.77
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25@2.75)	27.37	28.05
BIRMINGHAM		
No. 2 Foundry (silicon 2.25@2.75)	**19.00@19.50**	18.00@18.50
PHILADELPHIA		
Eastern Pa., No. 2X (2.25@2.75 sil.)	22.26	21.77@22.27
Virginia No. 2 (silicon 2.25@2.75)	29.17	28.44@29.44
Basic	21.16	20.00@21.00
Gray Forge	.....	21.00@22.00
CHICAGO		
No. 2 Foundry Local (silicon 1.75@2.25)	22.00	20.00
No. 2 Foundry Southern (silicon 2.25@2.75)	25.55	25.05
PITTSBURGH, including freight charge ($1.76) from the Valley		
No. 2 Foundry Valley (silicon 1.75@2.25)	20.77	22.77
Basic	20.77	22.77
Bessemer	20.77	25.26

SCRAP—The prices following are f.o.b., per gross ton paid to dealers and producers:

	New York	Chicago	Birmingham
No. 1 railroad wrought	$14.75	*$14.00@$14.50*	$12.00@$13.00
Stove plate	11.50	*14.25@ 14.75*	13.00@ 13.50
No. 1 machinery cast	18.25	*17.00@ 17.50*	16.00@ 16.50
Machine shop turnings	10.25	*7.50@ 8.00*	7.00@ 8.00
Cast borings	9.75	*11.50@ 12.00*	7.00@ 8.00
Railroad malleable	15.25	*16.00@ 16.50*	17.00@ 18.00
Re-rolling rails	14.50	*16.90@ 17.40*	16.50@ 17.00
Re-laying rails	23.50	.....	21.00@ 22.00
Heavy melting steel	12.25	.....	.....

* Dealers purchasing prices except No. 1 machinery cast.

Railway Supplies

STEEL RAILS—The following quotations are per ton f.o.b. for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh Oct. 1	Pittsburgh One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43.00	$43.00	$43.00	$43.00	$47@49
Standard openhearth rails	43.00	43.00	43.00	43.00	49@50
Light rails, 8 to 10 lb.	32@34	38@39	34@36	1.80@1.90	.....
Light rails, 12 to 14 lb.	32@34	38@39	34@36	1.80@1.90	1.90@1.95*
Light rails, 25 to 45 lb.	32@34	37@38	34@36	1.80@1.90	1.85@1.90*
Re-rolled rails	27@30	33@35	.....	.....	18.50

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, white oak, plain	$1.40	$1.75
Chicago, empty cell creosoted	1.75	2.10
Chicago, zinc treated	1.55	1.90
San Francisco, green Douglas fir	.84	1.14
San Francisco, empty cell creosoted, Douglas fir	1.70	2.25
St. Louis, white oak, plain	1.00	1.25
St. Louis, zinc treated	1.40	1.60
St. Louis, red oak, plain	.90	1.15
St. Louis, sap pine-cypress	.75	1.00
Birmingham, white oak	1.25	1.45

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh mill for carload lots, together with the warehouse prices at the places named:

	Pittsburgh Oct. 1	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅜-in. and larger	$2.70@$2.80	$2.80	$3.55	$3.65	$4.35	$2.90
Track bolts	3.90@ 4.15	3.75@4.00	4.55	3.25	5.85	3.90
Standard section angle bars	2.75	2.75	3.30	3.25@3.75	4.00	3.85

Pipe

WROUGHT PIPE—The following discounts are to jobbers for carload lots at Pittsburgh mill:

BUTT WELD

Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
1 to 3	62	50½	1 to 1¼	33	13
LAP WELD					
2	55	43½	2	23	7
2½ to 6	59	47½	2½	26	11
7 and 8	56	43½	3 to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1¼	60	49½	1 to 1¼	30	14
2 to 3	61	50½			
LAP WELD, EXTRA STRONG, PLAIN ENDS					
2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

STEEL PIPE—From warehouses at the places named the following discounts hold for welded steel pipe:

	Black New York	Black Chicago	Black Birmingham	Black St. Louis
1 to 3 in. butt welded	53%	54%	62%	49%
3½ to 6 in. lap welded	48%	51%	59%	46%
	Galvanized New York	Galvanized Chicago	Galvanized Birmingham	Galvanized St. Louis
1 to 3 in. butt welded	39%	41%	50%	36%
3½ to 6 in. lap welded	35%	38%	47½%	33%

Malleable fittings, Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36—5% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham	Pittsburgh	New York Oct. 1	New York One Year Ago
4 in.	$45.00	$53.70@54.20	$55.60@56.60	$61.60@62.60
6 in. and over	41.00@42.00	$49.70@50.20	50.60@51.60	56.60@57.60
		Chicago	St. Louis	San Francisco
4 in.		$53.20@54.20	$52.00	$59.00
6 in. and over		49.20@50.20	48.00	54.00

Gas pipe and Class "A," $4 per ton extra.

CLAY DRAIN TILE—The following prices are per 1,000 lin.ft.:

Size, In.	New York Oct. 1	New York One Year Ago	St. Louis	Birmingham	San Francisco	Dallas
3	$48.00	$45.00	$40.00	$45.00	.....	$73.00
4	50.00	55.00	40.00	56.00	$76.50	110.00
5	70.00	80.00	.....	80.00	97.75	118.00
6	92.00	105.00	70.00	100.00	127.50	150.00
8	160.00	170.00	170.00	165.00	212.50	210.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In.	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	.....	$0.081	$0.10	.....	$0.09	$0.12	.....
4	.....	.081	.10	$0.10	.09	.15	$0.15
5	.....	.1215	.135	.....	.13½	.18	.18
6	$0.21	.1215	.135	.14	.13½	.21	.21
8	.35	.189	.21	.225	.21	.30	.325
10	.52	.2835	.315	.315	.31½	.42	.476
12	.66	.3645	.45	.405†	.40½	.56	.612
15	1.14†	.476	.54	.675†	.54	.92	1.02
18	1.65†	.675	.75	.945†	.75	1.32	1.53
20	1.98†	.81	.90	1.26†	.90	.....	.....
22	2.65†	1.08	1.20	.....	1.20	.....	1.564
24	2.97†	1.215	1.35	1.62†	1.35	2.16	2.04
27	4.65†	2.405	2.665	2.45†	2.75	3.00	3.34
30	5.16†	2.664	2.952	3.00†	3.75	3.60	4.06
33	6.98†	3.60	3.96	3.55†	4.50	.....	4.99
36	8.00†	4.10	4.51	3.95†	5.00	.....	5.42
	3	5	8	12	24	36	
Boston	$0.13	*$0.19*	$0.30	$0.60	$2.00†	$5.50†	
Minneapolis	.....	.....	.225	.405	1.35	4.75	
Denver	.135*	.18*	.27	.47	1.70	.....	
Seattle	.14	.....	.35	.72†	2.60†	.....	
Los Angeles	.1625	.195	.275	.495	1.65	.....	
New Orleans	.115*	.117*	.295	.4725	1.575	.....	
Cincinnati	.105	.1575	.245	.4725	1.575	4.715	
Atlanta	**.10***	**.15***	**.24**	**.40**	**1.55**	.....	
Montreal	.68‡	.45†	.70	1.35	4.50†	.....	
Detroit	.07	.1125	.175	.3375	1.935†	5.6375†	
Baltimore	.111	.166	.259	.499	1.665	4.92	
Kansas City, Mo.	.13*	.21	.32	.52	2.16	.....	
Philadelphia	.12	.18	.28	.54	1.80	**4.66**	

*4-in., 6-in., 9-in., respectively. †Double Strength. ‡3-in. special.

Road and Paving Materials

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

		Oct. 1	One Year Ago
New York, 45% asphalt	(at terminal)	$0.065 @$0.07	$0.055
New York, 65% asphalt	(at terminal)	.0675@ .0725	.06
New York, binder	(at terminal)	.07 @ .075	.065
New York, flux	(at terminal)	.07 @ .075	.04
New York, liquid asphalt	(at terminal)	.07 @ .075	.06
St. Louis, 40@50% asphalt		.05	.0475
St. Louis, 50@60% asphalt		.051	.0581
Birmingham, 55% asphalt		.0475	
Dallas, 45% asphalt		.05	.0495
Dallas, 55% asphalt		.046	.0455
Dallas, binder		.062	.061
San Francisco, binder, per ton		13.50*	11.00*

* F.o.b. Oleum, Cal. Freight to San Francisco, 80c. per ton.

E. N.-R. Prices of Construction Materials

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Mexican*)	*$23.00**	*$18.50*
Boston (*Mexican*)	22.50	18.00
Chicago (*Texas*)	27.00	23.00
San Francisco, *f.o.b. refinery*, Oleum, Cal.	19.50	13.50
Dallas (*Texas*)	27.10	21.10
Seattle, "*D*" *grade, California, f.o.b. Richmond*	19.50	13.50
Denver (*California*)	24.00	....
Minneapolis, *f.o.b. Twin Cities* (*Stanolind*)	27.60	21.60
St. Louis (*Mexican*)	25.00	21.00
Baltimore (*Mexican*) (*f. o. b. refinery*)	22.50	18.50
Montreal (*Imperial*)	28.00	21.00
Atlanta (*Mexican*)	26.10	21.90
Detroit (*Mexican*)	27.00	23.00
Cincinnati (*Kentucky Rock*)	....	11.65
Maurer, N. J. (*Bermudez*)	28.00	26.00
Maurer, N. J. (*Mexican*)	22.00	19.00
Philadelphia (*Mexican*)	24.00	22.00
Kansas City, Mo. (*Texas*)	27.30	22.30
Los Angeles ("*D*" *grade, California*)	19.50†	13.50†
Birmingham (*Mexican*)	27.00	21.00
New Orleans (*Mexican*)	26.00	17.00

*In drums †f.o.b. El Segundo Refinery.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

PAVING STONE—

New York (grade I)	5-in. granite, 30 blocks per sq.yd.	$147.00 per M.
San Francisco	Basalt block 4x7x8	70.00 per M.
Chicago	about 4x8x4 dressed	3.60 per sq.yd.
	about 4x8x4 common	3.25 per sq.yd.
Boston	5-in. Granite	135.00 per M.
Atlanta	Granite	2.50 per sq.yd.
Detroit	5-in. Granite	3.00 per sq.yd.
Baltimore	Granite	2.85 per sq.yd.
Montreal	Granite	104.75 per M.
New Orleans	Granite, 4x8x4	*3.18* per sq.yd.
Cincinnati	Granite	135.00 per M.
St. Louis	Granite, 4x8x4	1.65 per sq.yd.
Kansas City	Granite	3.85 per sq.yd.
Philadelphia	Granite	3.90@4.25 per sq.yd.
Minneapolis	Sandstone	2.74 per sq.yd.

FLAGGING—

New York	Bronx, 4 ft. wide	$0.24 per sq.ft.
	Manhattan, 4 ft. wide	.24 per sq ft.
	Queens, 5 ft. wide	.26 per sq.ft.
	6x24-in. cross-walk	1.30 per lin.ft.

CURBING—*New York*: Bluestone per lin.ft., f.o.b. barge New York, 5x16 in., 88c.; *St. Louis*: Class "A" straight, delivered, 5x18 in., $1.05 per lin.ft.; roundings, $1.60. *Birmingham:* Limestone, 5x18-in., $1.05 per lin. ft.

WOOD BLOCK PAVING—

	Size of Block	Treatment	Per Sq.Yd
New York	3	16	$2.40
New York	3½	16	2.70
Boston	3½	18	*2.50*
Chicago	4	16	2.25
Chicago	3½	16	2.10
St. Louis	3½	16	2.40
St. Louis	4	16	2.70
Seattle	4	16	Off market
Minneapolis	3½	16	2.40
Atlanta	3½	16	2.00
New Orleans	3	16	2.20
New Orleans	3½	16	2.30
New Orleans	4	16	2.40
Dallas	4	18	3.90
Baltimore	3½	16	None used
Montreal	4	16	4.50
Detroit	3	16	1.94
Detroit	4	16	....
Cincinnati	3½	16	2.35
Kansas City	4	16	3.75
Philadelphia	4	16	None used

Construction Materials

SAND AND GRAVEL—Price, f.o.b., for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel 1½ In. Oct. 1	Gravel 1½ In. One Year Ago	Gravel ¾ In. Oct. 1	Gravel ¾ In. One Year Ago	Sand Oct. 1	Sand One Year Ago
New York (*alongside dock*)	$1.75	$1.75	$1.75	$1.75	$1.00	$1.00
Denver	1.90	1.90	1.90	1.90	1.00	1.00
Chicago	1.57½	2.75	1.57½	2.75	1.47½	2.75
St. Louis	1.45	1.45†	1.45	1.65†	1.18	1.18†
Seattle	1.50	1.50	1.50	1.50	1.50	1.50
Dallas	2.38	2.38	2.38	2.38	2.00	2.00
Minneapolis	1.65*	1.85*	1.65*	1.85*	1.25	1.25
Cincinnati	1.40†	1.40†	1.40†	1.40†	1.35†	1.35†
San Francisco	2.15	2.15	2.15	2.15	1.50	1.50
Boston	1.50†	1.45†	1.50†	1.45†	1.00†	1.00†
New Orleans	2.60	3.00	2.60	3.00	1.75	1.25
Los Angeles	0.85*†	0.75*†	0.85*†	0.80*†	0.50*†	0.50*†
Atlanta	2.20†	1.90†	2.20	1.90†	1.65†	1.40†
Detroit	2.02	2.02	2.02	2.02	1.62	1.62
Baltimore	1.40	1.40	1.60	1.60	0.70*†	0.70*†
Montreal	1.25†	1.25†	1.25†	1.25†	1.25†	1.25†
Birmingham	2.00	2.00	2.00	2.00	1.50	1.30†
Philadelphia	2.10	2.10	2.10	2.10	1.50	1.50
Kansas City (Joplin chats)	4.00	3.20†	4.00	3.20†	0.66*†	....

New York—Grits, $1.75 per cu. yd.; ready mixed, $1.90.
Los Angeles—Freight from quarry, 70c. per ton, and is included in above price.
*At pit. † Per ton.

CRUSHED STONE—Price for car or carload lots, f.o.b. city is as follows per cu.yd.:

	1½ In. Oct. 1	1½ In. One Year Ago	¾ In. Oct. 1	¾ In. One Year Ago
New York	$1.75	$1.75	$1.85	$1.85
Chicago	1.72½	2.75	1.87½	2.75
St. Louis	1.83*	1.75*	1.83*	1.75*
Dallas	2.40	2.40	2.83	2.83
San Francisco	2.15	2.15	2.15	2.15
Boston	1.60*	1.50*	1.60*	1.50*
Minneapolis	1.75	1.75	1.75	1.75
Kansas City	1.50	1.50	1.50	1.50
Denver	2.50	3.50	2.50	3.50
Seattle	3.00	3.00	3.00	3.00
Atlanta	2.20*	2.00*	2.20*	2.00*
Cincinnati	1.90*	1.90*	1.90*	1.90*
Los Angeles	1.00*	1.15	1.00*	1.00
Detroit	1.90*	1.70	1.90*	1.70
Baltimore	2.50	2.50	2.55	2.55
Montreal	1.80*	2.25*	....	2.25*
Philadelphia	2.10	2.10	2.10	2.10
Pittsburgh	2.85	2.85	2.85	2.85
Cleveland	3.25*	3.25*	3.25*	3.25*
Birmingham	2.00	....	2.00	....

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plan

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.25	$1.35	$2.00	$1.25
Steubenville District	1.25	1.30	2.00	1.30
Ironton District	1.40	1.40	2.00	1.40
Easton, Catasauqua, Pa.	....	....	2.50	....
Birmingham, Ala.	.80@.90	1.15	2.05	....
Buffalo, N. Y., and Erie, Pa.	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.30	1.30	1.30	1.30
Easter Pa. and Northern N. J.	1.25	1.25	2.50	1.25
Western Pennsylvania	1.25	1.25	2.50	1.25
Longdale and Glen Wilton, Va.	1.25	1.25	2.50	....
Toledo, Ohio	1.25	1.25	1.50	1.25

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	Lump, per Barrel Common
New York	$18.20	$12.00@$13.10	$3.50*	$2.25@2.75*
Chicago	20.00	18.00	1.45†	*1.30*†
St. Louis	23.00	19.00	14.00‡	14.00†
Boston	19.50	13.25@14.75	3.75*	3.00*
Dallas	18.00	....	.....	1.85†
Cincinnati	16.60	14.30	.....	13.40‡
San Francisco	....	22.00	.....	1.60†
Minneapolis	25.50	21.00 (white)	1.60@1.70†	1.35†
Denver	24.00	.....	.....	2.70*
Detroit	12.40	12.40	.....	17.00‡
Seattle, *paper sacks*	24.00	.....	2.80†	
Los Angeles	25.00	18.00	3.50	19.50‡
Baltimore	24.25	.....	2.55†	
Montreal	.....	21.00	.....	10.50‡
Atlanta	22.50	14.00	2.00†	1.30†
New Orleans	24.00	16.00	2.50†	2.00*
Philadelphia	23.00	.....	1.21†	
Kansas City	18.50	17.50	*2.45**	2.10*
Birmingham	22.50	15.00	2.40†	1.85†

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton.

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, exclusive of bags:

	Oct. 1	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	*1.45*	1.35
Cincinnati (Utica)	1.72	1.72
Boston (Rosendale)	2.75	2.50
St. Louis (Carney)	2.35	2.35
Birmingham (Magnolia) pozzolan cement	2.40	2.10

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b points listed *without bags*. Cash discount not deducted.

	Oct. 1	One Month Ago	One Year Ago
New York, del. by truck	$2.50@2.60	$2.50@2.60	$2.50@2.60
New York, alongside dock to dealers	2.15	2.15	2.15
Jersey City	2.33	2.33	2.33
Boston	*2.40*	2.45	2.70
Chicago	2.20	2.20	2.20
Pittsburgh	2.19	2.19	2.19
Cleveland	2.39	2.39	2.39
Detroit	2.35	2.35	2.40
Indianapolis	2.39	2.39	2.41
Milwaukee	2.35	2.35	2.35
Duluth	2.19	2.19	2.19
Peoria	2.37	2.37	2.37
Cedar Rapids	2.44	2.44	2.44
Davenport	2.39	2.39	2.39
St. Louis	2.30	2.30	2.30
San Francisco	2.31	2.31	2.61
New Orleans	2.40	2.40	2.40
Minneapolis	2.42	2.42	2.42
Denver	2.84	2.84	2.84
Seattle	2.65	2.65	2.90
Dallas	2.05	2.05	2.05
Atlanta	2.25	2.25	2.35
Cincinnati	2.47	2.47	2.47
Los Angeles	2.52	2.52	2.98
Baltimore	2.50	2.50	2.90
Birmingham	2.40	2.40	2.40
Kansas City, Mo.	2.30	2.36	2.70
Montreal	1.80	1.80	1.80
Philadelphia	2.41	2.41	2.41
St. Paul	2.42	2.42	2.42
Toledo	2.40	2.40	2.45

NOTE—Bags 10c. each, 40c. per bbl.; 20c. each in Canada, 80c. per bbl.

Current mill-prices per barrel in carload lots, without bags, to contractors:

Buffington, Ind.	$1.95	Hudson, N. Y.	$2.05
Universal, Pa.	1.95	Leeds, Ala.	1.95
Steelton, Minn.	2.00	Hannibal, Mo.	2.05
Fordwick, Va.	2.05	Lehigh Valley District	1.95
Mitchell, Ind.	2.05	Wyandotte, Mich.	2.10
Iola, Kan.	1.95	Alpena, Mich.	1.95
Mason City, Ia.	2.00	Richard City, Tenn.	2.05
La Salle, Ill.	2.05	Kingsport, Tenn.	2.05

E. N.-R. Prices of Construction Materials

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Chicago District Mill	Warehouse: New York	St. Louis	Dallas	San Francisco
032	22	$0.97	$1.01	$1.39	$1.06	$1.13	$1.22
049	28	1.23	1.29	1.76	1.35	1.38	1.55
068	35	1.51	1.58	2.16	1.66	1.67	1.91
093	45	1.94	2.03	2.77	2.13	2.00	2.46
126	57	2.39	2.51	3.45	2.63	2.55	3.03
153	68	2.86	2.99	4.11	3.14	3.15	.....
180	78	3.28	3.43	5.70	3.60	3.47	.....
245	163	4.33	4.53	6.21	4.75	4.58	.....
287	119	5.00	5.24	7.19	5.50	5.26	6.35
336	138	5.80	6.07	8.35	6.37	6.11	.....
395	160	6.72	7.04	9.65	7.38	7.12	.....
		PAVING					
036P	17	$0.74	$0.77	$1.06	$0.81	$0.76	.....
053P	24	1.04	1.09	1.50	1.14	1.07	.....
072P	31	1.32	1.38	1.90	1.45	1.39	.....
097P	40	1.70	1.78	2.45	1.87	1.90	.....
049R	24	1.04	1.09	....	1.14	1.07	.....
067R	31	1.32	1.38	....	1.45	1.39	.....
089R	40	1.70	1.78	....	1.87	1.90	.....

In rolls, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in. wide x 150 ft. long, or 600 sq.ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted:

Weight in pounds	New York	Birmingham	Chicago	St. Louis	San Francisco	Dallas
2.2	$19.00	$22.00	$21.00	$21.00	$24.00	$23.50
2.5	20.50	23.00	23.00	23.00	26.00	25.00
3.0	23.50	26.00	27.00	27.00	30.00	28.50
3.4	25.00	28.00	29.00	29.00	33.00	31.00

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham	Warehouse, Uncut: New York	Chicago	St. Louis	Dallas	San Francisco
½ and larger	$1.90@2.00	$2.25	$3.24	$3.00	$3.15	$3.38	$3.35
⅝	2.00@2.10	2.35	3.34	3.10	3.25	3.43	3.45
¾	2.10@2.20	2.45	3.44	3.20	3.35	3.48	3.55
⅞	2.30@2.40	2.65	3.64	3.40	3.55	3.63	3.75
1	2.90@3.00	3.25	4.24	4.00	4.15	3.78	4.35

For size and cutting extras, see bar card of July 15, 1923.

ROLLED FROM RAILS

	St. Louis	Dallas		St. Louis	Dallas
½ and larger	$2.55	$2.80	⅝	$2.95	$3.02
¾ in.	2.65	2.85	1	3.55	3.50
⅞	2.75	2.90			

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Oct. 1	One Month Ago	One Year Ago	Paving Block: 3-inch*	3½-inch*
New York (del.)	$17.50@18.00	$17.50@18	$17.00	$45.00	$51.00
New York (at dock)	14.50@15.00	14.50@15	14.00	.....	.....
Chicago	12.00	12.00	12.00	42.00	45.00
St. Louis, salmon (del.)	16.00	16.00	16@18	37.50	40.00
Denver, salmon	12.00	12.00	12.00	.....	.....
Dallas	11.60	11.60	12.10	35.00	.....
San Francisco	15.50	15.50	15.50	.....	.....
Los Angeles	11.50	11.50	15.00	(not used)	
Boston (del.)	*17.50*	18.00	22.00	45.00	51.00
Minneapolis (del.)	13.50	13.50	14.00	.....	.....
Kansas City	16.00	16.50	16.50	(no market)	
Seattle	15.00	15.00	15.00	.....	42.50
Cincinnati	17.00	17.00	17.00	40.00	45.00
Montreal	17.50	17.50	17.50	100.00†	68.00
Detroit (del.)	16.00	16.00	17.50	37.50	40.50
Baltimore	18.00	17.00	18.00	40.00	45.00
Atlanta	10.50	10.50	11.00	40.00	.....
New Orleans	15.00	15.00	19.50	.....	.....
Birmingham	12.50	12.50	12.50	40.00	45.00
Philadelphia	*15@19.00*	19.00	19.00	40.00	50.00
Pittsburgh (del.)	16.00	16.00	16.00	.....	.....
Cleveland	14.00	14.00	16.00	.....	.....

*For paving blocks 3x8½x4 and 3½x8½x4 respectively. †Imported.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: Oct. 1 on Trucks*†	New York: One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco†	Perth Amboy N. J., Factory*
4x12x12	*$0.1027*	$0.1162	$0.075	$0.12	$0.07	$0.108	.....
6x12x12	*.1541*	.1743	.096	.....	.095	.156	.....
8x12x12	*.1926*	.2179	.135	.22	.132	.244	.....
10x12x12	.....	.....	.167	.....	.165	.....	$0.252
12x12x12	.....	.....	.215	.....	.195	.....	.312

*5 per cent off for cash. †Partition tile.

	4x12x12	8x12x12	12x12x12
Boston	*$0.085*	*$0.17*	.....
Minneapolis (f.o.b. cars)	.0636	.106	$0.189
Minneapolis (delivered)	.07	.116	.205
Cincinnati	.07485	.13745	.....
Kansas City	.085	.145	.....
Denver	.085	.155	.188
Seattle (delivered)	.10	.20	.30
Los Angeles	.085	.172	.....
New Orleans	.13	.20	.....
Detroit (delivered)	.1095	.2033	.2821
Montreal	.12	.225	.30
Baltimore	.125	.27	.....
Atlanta	.0893	.1674	.....
Dallas	.10	.19	.275
Birmingham	.11	.1824	.22
Pittsburgh (delivered)	.068	.128	.179
Cleveland	.07	.149	.....

STRUCTURAL MATERIAL—Following are base prices f.o.b. mill, Pittsburgh and Birmingham, together with quotations per 100 lb. from warehouses at place named:

	Pittsburgh Mill	Birmingham	Warehouse: New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	$1.90@2.00	$2.05	$3.34	*4.00*	$3.25	$3.10	$3.30
Channels, 3 to 15 in.	1.90@2.00	2.10	3.34	*4.00*	3.25	3.10	3.30
Angles, 3 to 16 in., ¼ in. thick	1.90@2.00	2.10	3.34	*4.00*	3.25	3.10	3.30
Tees, 3 in. and larger	1.90@2.00	2.10	3.34	*4.00*	3.35	3.10	3.30
Plates, ¼ in. thick and heavier	1.80@1.90	2.00	3.34	*4.00*	3.25	3.10	3.30

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh Mill	New York: Oct. 1	New York: One Yr. Ago	Warehouse: Chicago	St. Louis	San Francisco	Dallas
½ in.	$2.40@2.50	$4.50	$3.75	$3.50	$3.65	$5.00	$4.75
CONE HEAD BOILER							
½ in.	*$2.60@2.70*	$4.70	$3.85	$3.70	$4.20	$5.20	$5.00
⅝ and ¾	*2.75@2.85*	4.85	4.01	3.80	4.45	5.35	5.15
¾ and ⅞	*3.00@3.10*	5.10	4.25	4.05	4.60	5.60	5.50

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh Mill	Birmingham	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2.65	$2.85	$3.15	*$3.40*	$4.20	$2.90	4.95
Cut	2.90	2.90	....	5.00	5.00	3.30	5.00

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco: Galv.	San Francisco: Black	Seattle Black
½	$7.50	$5.75	$7.75
⅝	7.05	5.30	5.65
¾	6.90	5.15	5.50

Pittsburgh base in lots of 200 kegs or more, $3.25.

PREPARED ROOFINGS—Slate-surfaced roofing in rolls of 108 sq.ft. costs $2.00@$2.75 per roll to contractors in carload lots f.o.b. New York.

Single shingles, slate finish, cost $7.00 per square (sufficient to cover 100 sq.ft.) in carload lots, f.o.b. New York. Strip shingles (4 in.) f.o.b. New York, in carload lots to contractors, $5.00 per square.

ROOFING MATERIALS—Prices f.o.b. New York, to contractors in carload lots:

Tar felt (14 lb. per square of 100 sq.ft.) per ton	$70.00
Asphalt roofing (in barrels), per ton	25.00
Asphalt felt, per ton	75.00

WINDOW GLASS—United inches, 25, bracket size 6x8 to 10x15, single thickness "AA," 82 per cent; "A," 87 per cent; "B," 88 per cent. Double thickness "AA," 82 per cent; "A," 88 per cent; "B," 89 per cent discount from jobbers list at New York warehouses.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	*$2.25@2.30*	$3.60	$3.50	$3.70	$3.89
No. 12	*2.30@2.35*	3.65	3.55	3.75	3.94
No. 14	*2.35@2.40*	3.70	3.60	3.80	3.99
No. 16	*2.45@2.50*	3.80	3.70	3.90	4.09
Black					
*Nos. 17 to 21	2.95@3.05	4.30	3.80	4.45	4.15
*Nos. 22 to 24	3.00@3.10	4.35	3.85	4.50	4.20
*No. 26	3.10@3.15	4.40	3.90	4.55	4.25
*No. 28	3.15@3.25	4.50	4.00	4.65	4.35
Galvanized					
No. 10 and 11	3.20@3.30	4.50	4.00	4.75	4.35
No. 12 to 14	3.30@3.40	4.60	4.10	4.85	4.45
No. 16	3.45@3.55	....	....	5.00	4.60
Nos. 17 to 21	3.60@3.70	4.90	4.40	5.15	4.75
Nos. 22 to 24	3.75@3.85	5.05	4.55	5.30	4.90
*Nos. 25 and 26	3.90@4.00	5.20	4.70	5.45	5.05
*No. 28	4.20@4.30	5.50	5.00	5.75	5.35

* For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: Oct. 1	New York: One Year Ago	Chicago: Oct. 1	Chicago: One Year Ago
Raw in barrels (5 bbl. lots)	*$1.04*	$1.03	*$1.05*	$1.05

E. N.-R. Prices of Construction Materials

WHITE AND RED LEAD—Per 100-lb. keg, base price, f.o.b. New York:

	Dry		In Oil	
	Oct. 1	1 Yr Ago	Oct. 1	1 Yr. Ago
Red	$13.75	$14.75	$17.25	$16.25
White	15.75	14.75	15.75	14.75

Lumber

Prices wholesale, per M. ft. b.m., to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M. ft. additional.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$26.00	$27.00	$28.00	$31.00
3x6 and 8	26.00	27.00	28.00	31.00
4x4-6 and 8	26.00	27.00	28.00	31.00
3x10 and 12	26.00	27.00	28.00	31.00
3x14	30.00	30.00	32.00	34.00
4x10 and 12	26.00	27.00	28.00	31.00
4x14	30.00	30.00	32.00	34.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	$28.00	$30.00	$32.00
6x14	34.00	36.00	38.00
8x10	28.00	30.00	32.00
8x14	34.00	36.00	38.00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York		Chicago	
	20 Ft. and Under	22-24 Ft.	20 Ft. and Under	22-24 Ft.
3x4 to 8x8	$45.00	$46.00	$41.50	$42.50
3x10 to 10x10	50.00	51.00	45.50	46.50
3x12 to 12x12	54.00	55.00	53.50*	54.50*
3x14 to 14x14	62.00	63.00	59.50†	60.50†
3x16 to 16x16	69.00	70.00	67.50	68.50

Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5@$10 additional. Short leaf pine costs $3 per M. less.

* 4x12 to 12x12. † 4x14 to 14x14.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12x12 and under; for sizes over 12x12 add $2; for merchantable add $2 to sizes 10x10 and under.

Other Cities

	8x8-In. x 20 Ft. and Under			12x12-In. 20 Ft. and Under	
	P.	Fir*	Hemlock	Spruce	P.	Fir*
Boston	$51.00	$48.00†	$51.00	$50.00	$60.00	$58.00†
Seattle	.....	30.50	.....	.....	.....	25.00
New Orleans	45.00	.....	.....	.....	35.00	.....
Baltimore	32.50	49.25	53.00	60.00	38.00	49.75
Cincinnati	37.00	73.00	73.00	85.00	48.00	77.00
Montreal	50.00	58.00	.....	.....	60.00	65.00
Los Angeles	.....	*37.00*	.....	.....	.....	*37.00*
Denver	.....	32.25	32.25	.....	.....	33.75
Minneapolis	43.00	*36.75*	35.00	.....	44.50	*36.75*
Atlanta	31.00	.....	.....	.....	34.00	.....
Dallas	56.00	.....	.....	.....	58.50	.....
Kansas City, Mo.	43.50	41.75	.....	.....	53.50	42.75
Birmingham	32.00	.....	.....	.....	34.00	.....
Philadelphia	56.00	34.00	37.00	40.00	67.00	34.00
Detroit	44.75	50.75	.....	.....	54.75	50.75
St. Louis	40.00	.....	.....	.....	50.00	.....

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir*	Hemlock	P.	Fir*
Boston	$46.00	$42.00†	$45.00	$51.00	$48.00†
Seattle	.....	26.00	.....	.....	30.00
New Orleans	83.00	.....	.....	43.00	.....
Baltimore	55.00	44.00	44.00	34.00	50.00
Cincinnati	70.00	79.00	75.00	38.00	85.00
Montreal	56.00	50.00	45.00	45.00	45.00
Los Angeles	.. ..	*32.00*	.....	.....	95.00
Denver	.....	29.25	29.25	.....	*30.25*
Minneapolis	43.00	*37.75*	34.75	38.00	*35.25*
Atlanta	18.00	.....	.....	28.00	.....
Dallas	52.00	.....	.....	56.00	.....
Kansas City, Mo.	50.25	40.25	.....	42.25	37.50
Birmingham	18.00	.....	.....	30.00	.....
Philadelphia	34.00	33.00	36.00	54.00	34.00
Detroit	37.25	37.50	.....	44.00	41.75
St. Louis	42.00	.....	.....	29.50	.....

Birmingham—Quotes carload lots, f.o.b. sidings; $4.00 additional per M. ft. to contractors.

Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.

Denver—Quotes dealers price to contractors on large projects.

St. Louis—Wholesale price to contractors, f.o.b. cars, $2 per M.ft. additional.

Seattle—Price to contractors, delivered.

Dallas—Wholesale to contractors, $10 per M.ft. additional.

*Douglas fir. †Prime.

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23½
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.21½	.25½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36½
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	.35	.41

Miscellaneous

STEEL SHEETPILING—The following price is base per 100 lb. f.o.b. Pittsburgh, with a comparison of a month and a year ago:

Oct. 1	One Month Ago	One Year Ago
$2.25@$2.30	$2.25@$2.30	$2.10@2.15

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Plow steel round strand rope	35%
Special steel round strand rope	30%
Cast steel round strand rope	20%
Round strand iron and iron tiller	5%
Galvanized steel rigging and guy rope	7½%
Galvanized iron rigging and guy rope	+12½%

California, Oregon, Nevada and Washington: Discount 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ¾-in., 8 ft.; ½-in., 6; ⅜-in., 4½; 1-in., 3½; 1¼-in., 2 ft. 10 in.; 1½-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston	$0.19@.24	New Orleans	$0.24½
New York	.27	Los Angeles	.24½
Chicago	.24	Seattle	.24
Minneapolis	.26½	St. Louis	.24½
San Francisco	.24	Montreal	*.15*
Atlanta	.34	Detroit	.26
Denver	.28	Baltimore	.18
Cincinnati	.21	Kansas City	.21
Dallas	.31	Birmingham	.30@.31
Philadelphia	.26		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.27	$0.295
Boston	.225	.25
Kansas City	.2025	.2225
Seattle	.165	.19
Chicago	.22	.245
Minneapolis	.1917	.2123
St. Louis	.22	.245
Denver	.2025	.2275
Dallas	.225	.302
Los Angeles	.1875	.2125
Atlanta	.23	.255
Baltimore	.22	.23
Cincinnati	.22	.245
Montreal	.195	.235
Birmingham	.23	.255
New Orleans	.233	.26
San Francisco	.1625	.1925
Philadelphia	.215	.24

CHEMICALS—Water and sewage treatment chemicals, spot shipments in carload lots, f.o.b. works:

Sulphate of aluminum, in bags, per 100 lb	$1.40@1.45
Sulphate of copper, in bbl., per 100 lb	4.50@4.60
Soda ash, 58%, in bags, per 100 lb	1.25
Chlorine, liquid, tanks, per lb	.04@.04½
Hypochlorite of lime (bleaching powder) in drums, per 100 lb	1.90@2.00

FREIGHT RATES—On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Atlanta	$0.58	Detroit	$0.29
Baltimore	.31	Kansas City	.735
Birmingham	.58	New Orleans	.67
Boston	.365	New York	.34
Buffalo	.265	Pacific Coast (all rail)	1.15*
Chicago	.34	Philadelphia	.32
Cincinnati	.29	St. Louis	.43
Cleveland	.19	St. Paul	.60
Denver	1.15*		

* Minimum carload, 50,000 lb., structural steel only; 80,000 lb., for other iron or steel products.